This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

NYPL RESEARCH LIBRARIES
3 3433 01925739 7

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

# THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

NEW YORK
PUBLIC
LIBRARY

VOLUME VI

APRIL 1913 TO MARCH 1914

Google

THE NEW YORK
PUBLIC LIBRARY
608281
ASTOR, LENOX AND
TILDEN FOUNDATIONS
R 1915

# The Post Office Electrical Engineers' Journal.

THE ORGAN OF THE INSTITUTION
OF POST OFFICE ELECTRICAL ENGINEERS.

**A QUARTERLY JOURNAL DEVOTED TO:**

**Telephones, Telegraphs (Aerial, Underground, Submarine and Wireless) and all matters of interest to Communication Engineers.**

*EDITED BY:*

J. SINNOTT, M.I.E.E.
A. W. MARTIN, A.M.I.E.E.
A. C. BOOTH.
J. W. ATKINSON, A.M.I.E.E.
A. O. GIBBON, A.M.I.E.E.
W. T. HARRIS.

W. CRUICKSHANK, A.M.I.E.E.
Managing Editor.

## VOLUME VI.

No. 1—April, 1913 ... ... Pages 1 96
No. 2—July, 1913 ... ... ,, 97 224
No. 3—October, 1913 ... ... ,, 225 320
No. 4—January, 1914 ... ... ,, 321 432

Digitized by Google

# INDEX.


PAGE

Aërial Loading. J. Whitehead . . . . . 57
Alternating Current Calculations. F. Addey, B.Sc., A.M.I.E.E. . 51, 187, 342
Anglo-German Telegraph Cable, A New. A. C. Booth . . . . 321
Anglo-Irish Telephone Cable, The New. J. G. H. . . . . 381
Arbitration, The Telephone. J. W. W. . . . . 225
Australian Relay Station, An, and Earth Current Observations Thereat. S. J. Willcox . . . . . 169
Automatic Exchange at Hereford, The Lorimer. W. J. Bailey, A.M.I.E.E. . 97
Awards. W. D. Robinson . . . . . 205

Baudot System, Progress of the. A. C. Booth . . . . . 324
British Coast Communication Wireless Service, Re-organisation of the. E. S. Perrin, B.Sc., A.M.Inst.C.E., and F. W. Davey . . . . . 351

Calculations, Alternating Current. F. Addey, B.Sc., A.M.I.E.E. . 51, 187, 342
Chess Club Notes . . . . . 207, 424
Circuit Plans. T. Howlett . . . . . 61
Classes, Workman's Technical . . . . . 387
Correspondence . . . . . 91, 270
Council Notes . . . . . 304, 410
Creed Telegraph System, The. E. Lack, A.M.I.E.E. . . . . 249

Dinner, Post Office Engineering Department, Ninth Annual . . . . 71
Distributing Election News by Telephone. G. F. O'Dell . . . . 66
Duct Work, Multiple-Way. J. Whitehead . . . . . 281

Electrical Devices at Platte Fougère Lighthouse. Edwin O. Catford . . 287

Ghent Exhibition, The. H. North . . . . . 198, 383

Hand Pumps, Pneumatic Tube. A. B. Eason, M.A. . . . . 378
Headquarters Notes . . . . . 80, 210, 301, 395
Heavy Renewal Work, An Experience in. J. W. Barber. . . . . 45

Inspectors in the Service of the Electric Telegraph Company (1850), Rules and Regulations to be observed by . . . . . 385
Insulation Resistance, Testing with Detector No. 2. . . . . 246

"Knight" Fire-alarm System, The. J. J. Markwick . . . . . 262

Library Notes . . . . . 429
Literature, References to Current Technical . . . . . 428
Loading, Aërial. J. Whitehead . . . . . 57
Local Centre Notes . . . . . 85, 215, 307, 413
London Chamber of Commerce and the Telephone Service, The . . . . 308
London Engineering District Notes . . . . . 84, 211, 273, 398
Lorimer Automatic Exchange at Hereford, The. W. J. Bailey, A.M.I.E.E. 97


Digitized by Google

PAGE

McCloskey, Mr. A. E. . . . . 429
Morkrum Printing Telegraph, The. Donald Murray, M.A., M.I.E.E. . . 175
Multiple-Way Duct Work. J. Whitehead . . . . . 281

Nesting Place, A Curious. T. B. J. . . . . 195

Obituary. John Jenkin, Sir W. H. Preece, K.C.B., Sir Robert Hunter, K.C.B., C. T. Fleetwood . . . . . 94, 401, 405, 409

P.O.C.B.F. A. J. Stubbs, M.Inst.C.E. . . . . 202
Plans, Circuit. T. Howlett . . . . . 61
Platte Fougère Lighthouse, Electrical Devices at. Edwin O. Catford . . 287
Pneumatic Tube Hand Pumps. A. B. Eason, M.A. . . . . 378
Pole, The Spectral . . . . . 92
Post Office Telephone and Telegraph Society of London, The . . . . 418
Power Plant for Moderate Range Wireless Stations. J. Coxon, A.M.I.E.E. 31

Recent Developments in Transportation. H. C. Gunton, M.I.E.E. . . 365
Regulation of Wires by means of Beams. G. M. Carr, M.I.E.E. . . . 182
Renewal of a number of Cables in the same Duct. J. W. Barber . . . 185
Retirements in 1913. Mr. J. W. Groves, Mr. T. Jenkyns, Mr. J. J. Hardie, Mr. Nelson Bathurst . . . . . 424, 426, 427, 428
Reviews, Book . . . . . 93, 221, 300, 390
Rules and Regulations to be observed by Inspectors in the Service of the Electric Telegraph Co. (1850) . . . . . 385

Secondary Cell Maintenance. J. G. L. . . . . 336
Some Personal Reminiscences of Sir W. H. Preece, K.C.B. H. R. Kempe . 401
Staff Changes . . . . . 95, 223, 319, 430
Standard Cable Measurements. B. S. Cohen, A.M.I.E.E. . . . . 1
Struck by Lightning. B. F. Gillett . . . . . 295
Superintending Engineers, Conference of . . . . . 206
Switch, A Useful . . . . . 69

Technical Literature, References to Current . . . . . 428
Telegraph Cable, A New Anglo-German. A. C. Booth . . . . . 321
Telegraph Engineer, The First . . . . . 196
Telegraphy, Early Days of . . . . . 26
Telephone Arbitration, The. J. W. W. . . . . 225
Telephone Cable, The New Anglo-Irish. J. G. H. . . . . 381
Telephone Progress in London. C. W. Muirhead . . . . . 155
Telephone Stations of the World at the Beginning of 1912. W. H. Gunston 161
Telephonic Development of the British Isles considered in Relation to the Population. W. H. Gunston . . . . . 21
Testing Insulation Resistance with Detector No. 2. W. A. . . . . 246
Transportation, Recent Developments in. H. C. Gunton, M.I.E.E. . . 365

White Ant, Ravages of the. J. M. Crawford . . . . . 274
Wireless Service, Reorganisation of the British Coast Communication. E. S. Perrin, B.Sc., A.M.I.E.E., and F. W. Davey . . . . . 351
Workmen's Technical Classes . . . . . 387

Digitized by Google

PAGE
429
175
281
195
5, 409
202
61
287
378
92
418
31
365
182
185
27, 423
00, 390
e
385
336
401
19, 439
1
295
200
69
428
321
196
26
225
381
155
n 161
e
21
24
305
274
351
367

Digitized by Google

PHOTOGRAPH OF A BIRMINGHAM LINEMAN IN THE EARLY DAYS OF TELEGRAPHY.
THE INTERIOR OF THE TOP HAT WAS USED AS A RECEPTACLE FOR TOOLS!
(*See p.* 28.)

Digitized by Google

THE
Post Office Electrical Engineers' Journal

# STANDARD CABLE MEASUREMENTS.

By B. S. Cohen, A.M.I.E.E.

Precautions necessary in S.C. Measurements.—It has been stated that standard cable measurements can only be considered as qualitative and not quantitative. This, however, is a misconception. By the use of trained observers, employing suitable precautions in order to reduce to a minimum, if not altogether to eliminate, the effects due to personal equation, it is possible to obtain standard cable measurements capable of repetition within a quarter of a mile of standard cable. This is amply close enough for practical purposes, and can be fairly considered as being well on the quantitative side of that somewhat nebulous line dividing quantitative and qualitative measurements.

The personal equation in standard cable measurements is undoubtedly a most serious factor in reducing the accuracy, and the most potent conditions which tend to affect it are enumerated below:

(*a*) Inexperience on the part of listener or speaker.

(*b*) Physical condition of the observer.

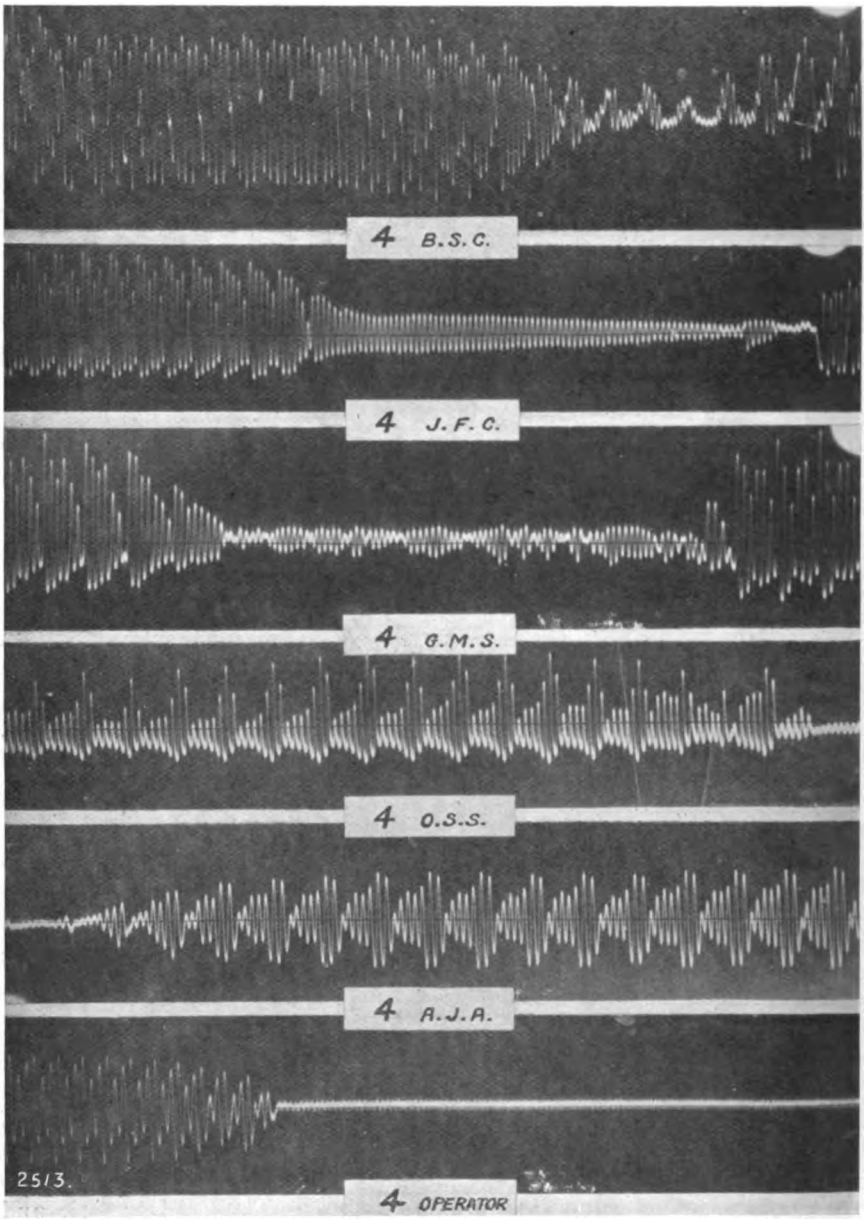
(*c*) Difference in articulation between the standard and the thing tested.

Speech Frequencies.—Care must be taken to ensure that no speaker has abnormal predominant frequencies in his voice, and some particulars of investigations into this question may be of interest.

1 shows oscillograms for five speakers repeating the number "four." Analyses of these wave forms, together with those of other



Digitized by Google



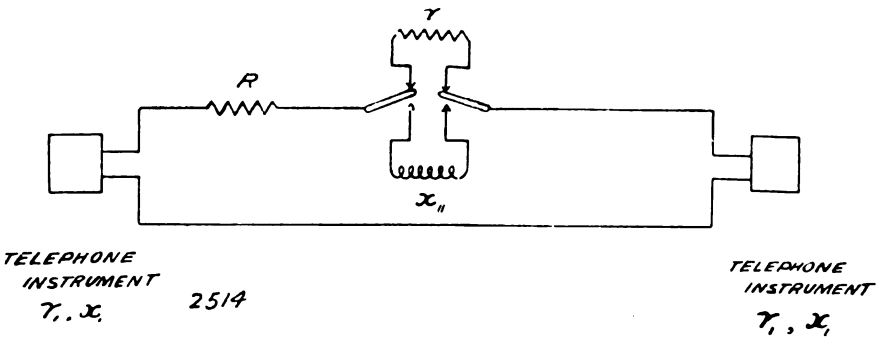

I.—Oscillograms of the Word "Four" for Five Male and One Female Speakers.



Digitized by Google

wave forms for the numbers one, two, three and five, indicate firstly that the last speaker (an operator and the only female on the test) has a fundamental frequency somewhat higher than that of any of the male speakers, but that the important harmonic, which in the speaking voice is invariably far greater in amplitude than the fundamental, was actually lower in frequency than in the case of any of the male speakers. This explains the general experience that female voices appear to be generally less attenuated than male when transmitted over long lines. It may be stated that this operator was selected for this test owing to her high and somewhat shrill speaking voice.*

The second point indicated by these wave forms is the considerable frequency range of the various male speakers, and a further research was made to get some indication of the variations occurring in different voices. The method adopted was to balance a fixed




2.—Circuit for Testing Speaker's Mean Frequency.

inductance against a variable resistance using the voice of the speaker under observation.

The circuit is indicated in **2**.

Two telephone instruments with known values of effective resistance $r_1$, and effective inductance $x_1$, were joined in series with a fixed resistance $R$, and either a fixed inductance $x_{11}$ or a variable resistance $r$. A speech balance was made in the usual manner, and $r$ was varied until the change from $r$ to $x_{11}$ gave the same volume of transmitted speech. Then, if $n$ is the effective frequency of the speech-wave used—

$$n = \frac{1}{2\pi}\sqrt{\frac{r^2 + 2Rr + 4r_1r}{x_{11}^2 + 4x_{11}x_1}}.$$

By this means, the apparent frequency of seven male speakers was ascertained with the following results.†

* See also writer's paper, "Production of Small Variable Frequency Alternating Currents suitable for Telephone and Other Measurements," 'Phil. Mag.,' September, 1908.

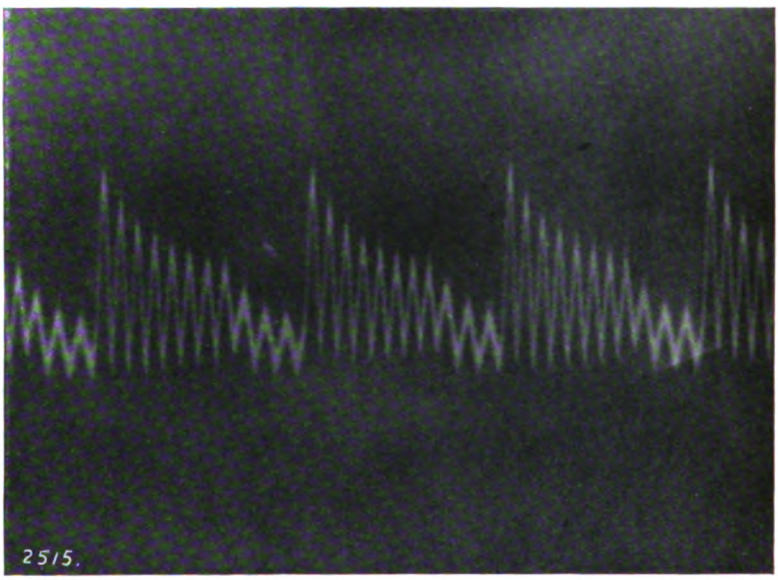
† See also Devaux Charbonnel, Paris Conference, 1910.



Digitized by Google

| Speaker. | Apparent ∽. |
|---|---|
| *a* | 307 |
| *b* | 352 |
| *c* | 545 |
| *d* | 656 |
| *e* | 758 |
| *f* | 958 |
| *g* | 1530 |

Speaker *g* was a man with an abnormally high speaking voice, whilst speakers *a* and *b* were abnormally low. It is obvious that the employment of either *a*, *b* or *g* separately on a speech test would give




3.—Artificial Speech Wave.

abnormal results, and that it is always advisable to balance the results obtained with a high-frequency speaker by those obtained using a low-frequency speaker. Furthermore, it is hopeless to expect a speaker such as *a* to give the same results in any standard cable test, when the allowance depended on frequency, as *f* or *g*.

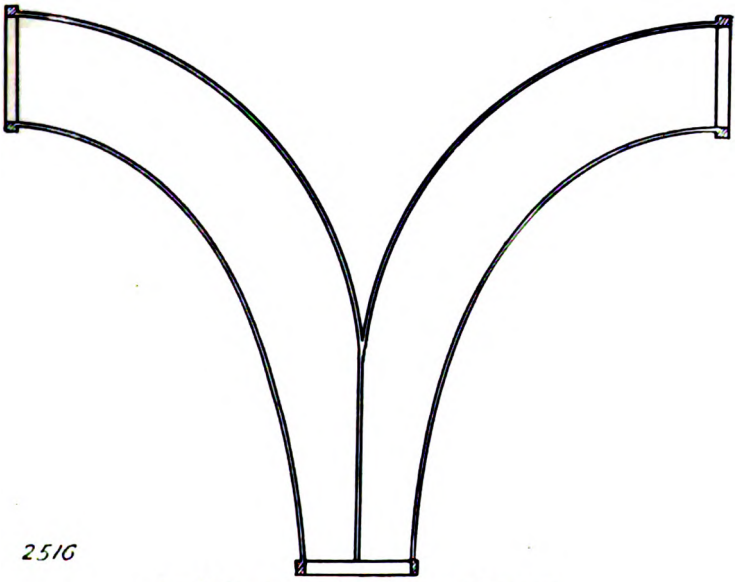
It may be of interest to mention here that S.C. measurements made with speakers counting the numbers one to five are not altered in value to any important extent if the speaker reads sentences, and this indicates that the words one, two, three, four and five fairly represent average speech.

Substitutes for the voice in S.C. Measurement.—Attempts have been made to replace the human voice by a



Digitized by Google

suitable complex wave form, but so far without entire success. The nearest approach to success obtained by the writer is by the use of a vibrating wire device producing two trains of damped oscillations, one of about 900 ~ and the other about 600 ~, the trains of oscillations being renewed about 100 times per second. An oscillogram of this wave form is shown in 3. This complex wave form was found to be a good substitute for the voice in comparing various types of lines, both loaded and unloaded, and to a certain extent for comparing receivers and transmitters, if of the same pattern, but resonance difficulties when comparing receivers or transmitters of different patterns indicate that this wave form is not a perfect




4.—Y-Tube for Transmission Testing.

substitute for that of the voice. The production of a complex wave of constant potential, which would give the same results as average speech under all conditions, would greatly facilitate standard cable measurements.

Definitions.—It is proposed in the remainder of this article to give all allowances in terms of standard cable and standard talking circuits, the latter consisting of No. 1 C.B. instruments connected to C.B. junction circuits (consisting of toroidal repeater, supervisory relay, and 22-volt battery) by a local line of zero resistance. By a piece of apparatus having an allowance of −5 S.M. is meant that the effect of introducing this apparatus into a circuit is to degrade the transmission to an extent equal to the introduction of five miles of standard cable.

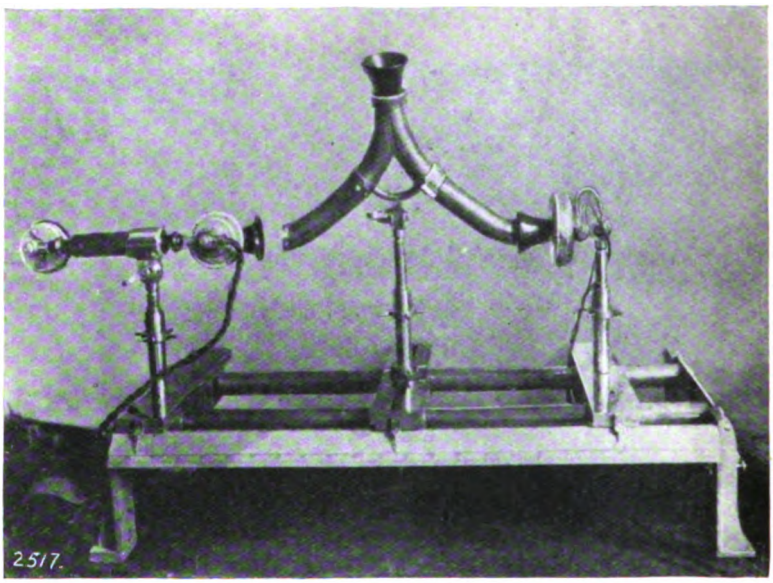


Digitized by Google

An improvement in the transmission is indicated by a + sign. This is specifically mentioned, as hitherto both this method of using the signs and the exact reverse have been employed.

TRANSMITTER AND RECEIVER ALLOWANCES.—In determining the allowance for transmitters and receivers, the variation inherent in all types must be counteracted by testing a sufficient number, and the number for any particular type of instrument will of course depend on the extent of its normal variation.

In some types, whilst instruments vary one from another to a




5 —ACOUSTICAL BENCH.

considerable extent, an individual instrument will vary very little in itself. The reverse, however, occasionally applies.

Another cause of increased difficulty in instrument testing is the necessity for determining the relative articulation values. It is the net audibility of an instrument that is, of course, required in order to determine its commercial value. The standard cable measurements, however, if carried out correctly, will only give the relative volume, and not the articulation, and any attempt to include the articulation value in the S.C. measurement will only result in vague qualitative values being substituted for quantitative ones. It is essential, then, for the obtaining of accurate results, to make the articulation test entirely independent of the volume test.

ARTICULATION TESTING.—For articulation tests the following



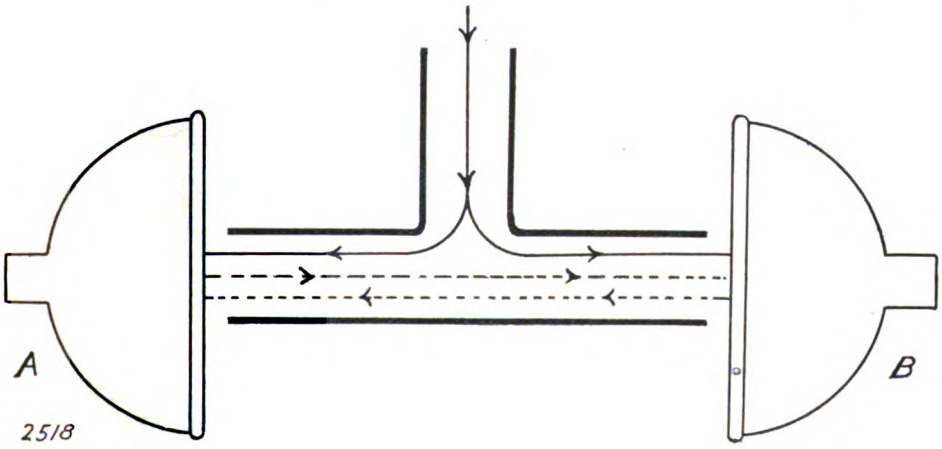
Digitized by Google

method has been adopted. Several lists of monosyllabic words have been prepared, each containing, say, 100 words.

All the words in each list must be similar to those in the other lists, *e. g.*—

| List 1. | List 2. | List 3. |
|---|---|---|
| mice. | spice. | rice. |
| rain. | main. | train. |
| car. | tar. | jar. |
| etc. | etc. | etc. |

If, say, a certain type of transmitter is being compared against a standard, one of these lists is read at a uniform and slow rate into the standard transmitter connected to an instrument through a suitable length of standard cable. The listener writes down the




6.—Reflection Error caused by T-Tube.

words as he receives them, and is not allowed to ask for a repetition of any word. Another list is then read out, by the same speaker, into the transmitter under comparison, over the same length of line.

By comparison of a number of such results, using different listeners and speakers, a fair relative idea of the articulation values may be obtained.

Probably a more scientific method may ultimately be found useful, and this would most likely take the form of a measurement of the variation in attenuation over a definite range of frequency. In general practice, although articulation is an extremely important factor, volume is usually the predominating factor in determining audibility.

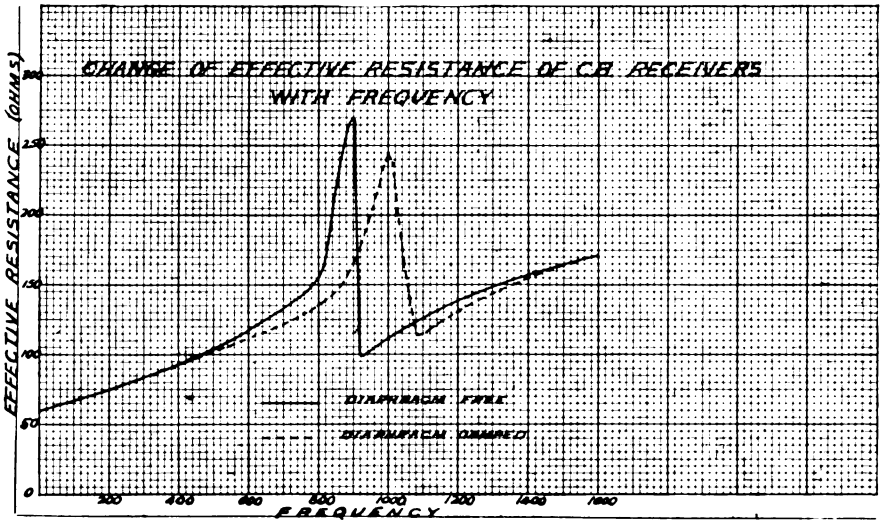
Use of Y Tubes.—In carrying out tests with transmitters or receivers one cause of inaccuracy is the necessity of shifting the



Digitized by Google

mouth or ear, as the case may be, from the standard to the instrument under test. This has been overcome by the introduction of the somewhat obvious device of a branching tube. The best form of tube is illustrated in section in 4, and 5 shows the tube mounted on what may be described as an acoustical bench and in use for transmitter testing. The shape of the tube, and the use of a partition as shown in the section, are both of considerable importance, as they minimise the reflection of sound between the diaphragms of the two instruments on the test. Considerable trouble was experienced from this effect with an earlier pattern of T-shaped tube.

6 illustrates the effects produced by this diaphragm reflec-




2519

7.—Variation of Effective Resistance with Frequency for Receiver with Diaphragm Free and Damped.

tion. A and B are two transmitters. B is assumed to be a transmitter whose diaphragm, or face generally, is less able to reflect sound-waves than A. It is obvious, then, that the total volume of sound received by A will be the direct portion (shown by full lines), plus that reflected from B (shown by dotted lines), and that this will be less than the total volume received by B.

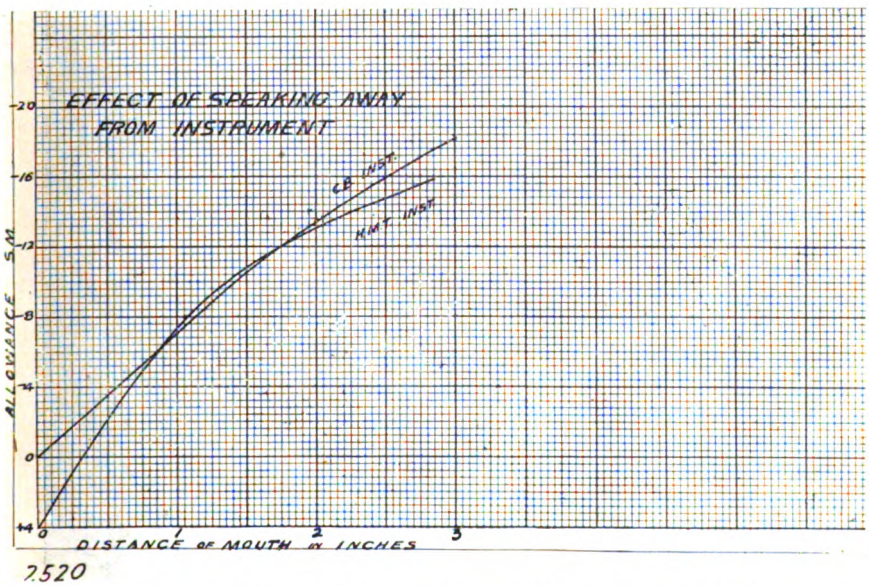
Similar effects are produced if the transmitters or receivers are of the same type but are placed at different distances from the ends of the tube.

When testing receivers a further difficulty is introduced by the fact that receiver efficiency is altered by variation in the size of the closed air chamber formed between the ear and the receiver



Digitized by Google

cap. That this is important is indicated also by the considerable variation in receiver impedance, and in the resonance point, if the diaphragm damping is varied. 7 gives curves for the variation of effective resistance with frequency of a P.O. standard receiver. The full curve is with the diaphragm free, and the dotted curve with the diaphragm damped by placing the receiver against a flat surface. In this way a column of air is enclosed in order to represent the condition of a receiver in actual use. The maximum points coincide with the resonance frequencies of the receivers under the two conditions. The curves are, of course, obtained using a constant current. It will be noted that when the receiver is




8.—Allowances in S.M. for Speaking at Different Distances from C.B. and H.M.T. Instruments.

tested under working conditions the resonance frequency is increased from 900 to 1000.*

Notes on C.B. Solid Back Transmitters.—Some points that have been noted in the course of testing many hundreds of transmitters may be mentioned here as of general interest.

The damping of the back of a transmitter diaphragm, caused by the enclosing in a metal shell, has the effect of appreciably reducing the efficiency, as such transmitters when tested without shells, and in consequence with the back of the diaphragm free to the air, improve on the average by about one standard mile.

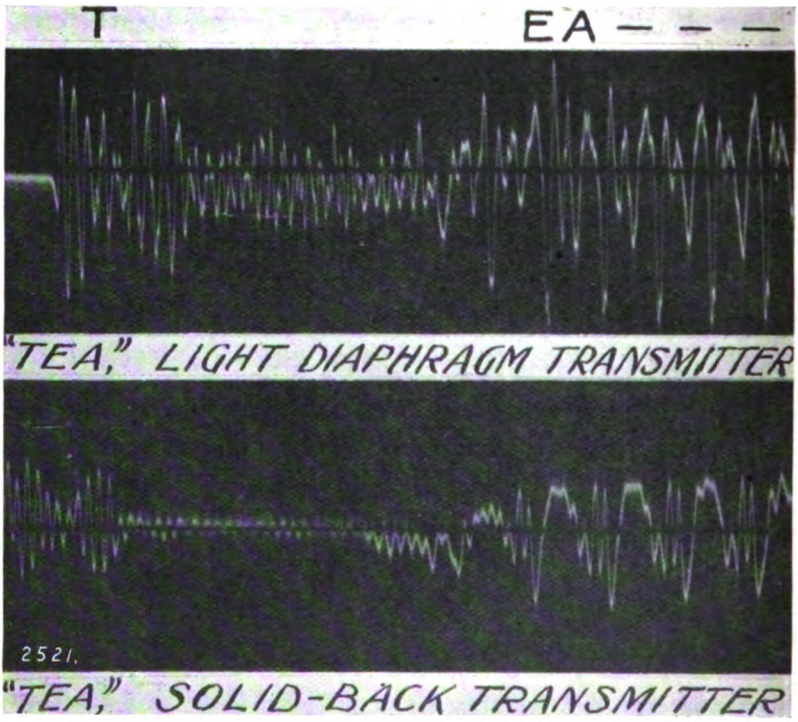
* See also Kennelly and Pierce, "Impedance of Telephone Receivers," 'Electrical World,' September 14th, 1912.



Digitized by Google

A very similar effect is found in receivers, and will be mentioned under that heading.

The solid back transmitter is generally very little affected in transmission qualities by age. Some of these transmitters, which were originally installed at subscribers' offices in connection with the first public C.B. exchange opened in this country, were removed after nine years' continuous service, and were found to have an average allowance of the order of ·7 S.M. better than the average




9.—Different Effect of Light Diaphragm H.M.T. and C.B. Solid Back Transmitters.

new transmitter of the same type supplied at the time the test was carried out.

No information existed as to the original allowance for these particular instruments. But a fair inference from the result of the tests is, that if the transmitters had not actually improved, yet the degradation due to age was negligible.

The falling off of volume due to increasing the distance between the mouth and mouthpiece with the solid back transmitter is shown in 8. The curve for an Ericsson hand micro-telephone is also given, and is referred to below.



Digitized by Google

NOTES ON LOCAL BATTERY TRANSMITTERS.—Of all transmitters, the allowance for the hand micro-telephone instrument has been one of the most difficult to determine with any degree of accuracy. The determination has, however, been materially assisted by the use of the acoustical bench and Y tube. One of the first problems in connection with a local battery transmitter is to find the true average condition for the primary cells used in connection with it, as it is obvious that the transmission efficiency will depend very considerably on the age of the cells. The definition adopted for a pair of average cells, as the result of researches with both dry and wet cells was: "A pair of cells whose P.D. after five minutes' connection to a resistance of 100 ohms was 2·3 volts and whose E.M.F. was 2·7 volts." It has been found convenient to obtain these conditions by the use of a potentiometer device connected to a four-volt accumulator.

With the types of hand micro-telephone in general use, the distance between the receiver and transmitter is invariable, and in consequence the distance between the mouth and the mouthpiece varies with the shape and size of the speaker's head. It follows that if any sort of definite allowance is to be obtained for such transmitters, an average mouth to mouthpiece distance must be obtained. An anthropological examination of about fifty persons resulted in the following figures for the Ericsson hand micro-telephone:

| | Inches. | Allowance in S.M. in terms of allowance at mean distance. |
|---|---|---|
| Maximum mouth to mouthpiece distance | 1·875 | − 5·1 |
| Minimum ,, ,, ,, | 0·375 | + 7·0 |
| Mean ,, ,, ,, | 1·0 | 0 |

There is a great deal of inherent transmission variation in hand micro-telephone transmitters, due partly, of course, to the alterations in angle and general movement to which the instrument is subjected, and also to the fact that all light diaphragm transmitters are extremely sensitive to external disturbances. 9 illustrates the difference between the two types of transmitter. This shows oscillograms of the word "tea" with both the solid back and hand micro-telephone transmitter. A mean of a large number of tests, taken under the average condition just described, indicate that the Ericsson hand micro-telephone transmitter has an allowance of −10 S.M. in terms of the standard C.B. transmitter working on a loop of zero resistance.

NOTES ON RECEIVERS.—The present standard pattern of 60 ohm Bell receiver is undoubtedly one of the best patterns so far produced, and is on the average 2 S.M. better than the older patterns

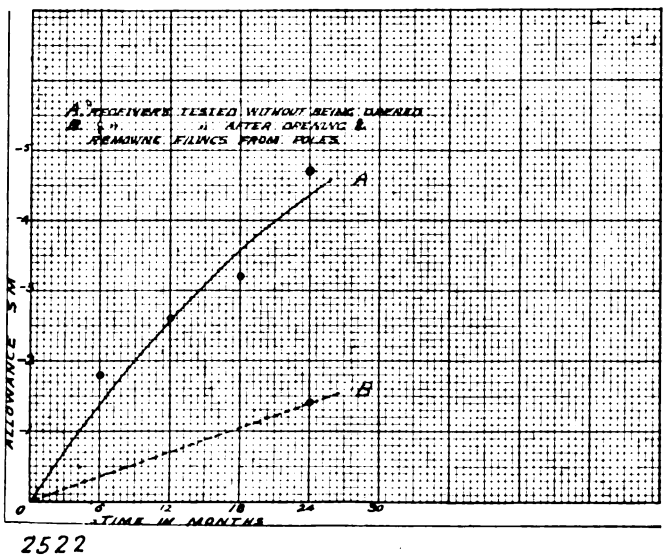


Digitized by Google

of this type. There are, however, quite a number of possibilities for further improvement from the transmission standpoint, and a few of these may be enumerated with advantage.

(*a*) Lamination of the pole-pieces appears to be a promising field for improvement. Some receivers, after fitting with pole-pieces of laminated stalloy, were improved to the extent of about 2 S.M., and this important matter is being further investigated.

(*b*) The perfect diaphragm is at present in process of evolution, and in this connection it is interesting to note that a stalloy diaphragm only gives an improvement of the order of ·5 S.M. with the P.O. pattern receiver as against over 1 S.M. with the older




**10.**—AGEING OF C.B. RECEIVERS.

pattern. The only difference between the new and the old pattern which appears likely to have affected this matter is the diaphragm diameter, which is $\frac{1}{8}$ in. smaller in the P.O. pattern.

(*c*) It is by no means certain that the best air-gap between pole face and diaphragm has been adopted. In older patterns of receivers, such as fitted on hand micro-telephones, etc., it was frequently the custom to employ a paper spacing ring. The air-gap with this type of ring was, however, not constant, as it depended on the force used in screwing up the receiver cap, the paper being decidedly compressible. This resulted in much variation in receiver efficiency, and when these rings were replaced by metal ones the investigation which determined the best thickness of ring to employ indicated that in all probability it would be safe to reduce

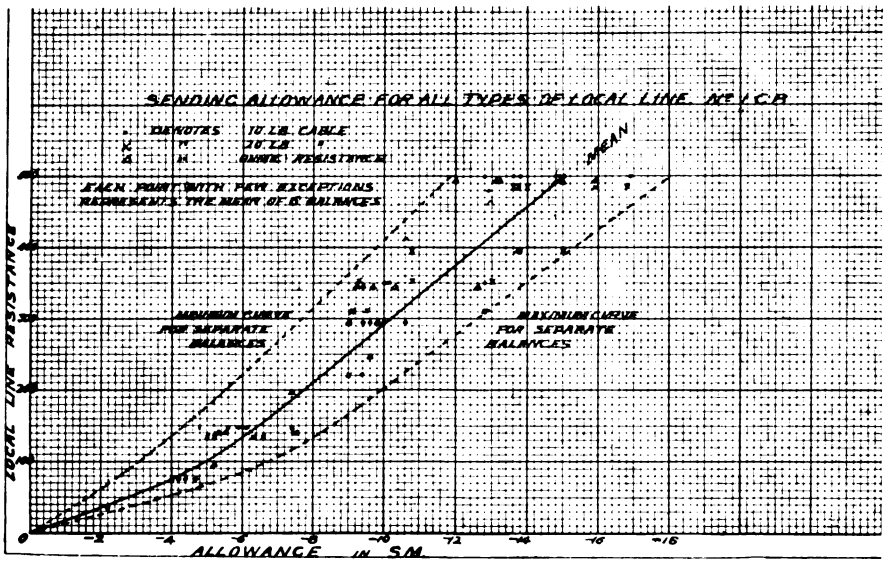


Digitized by Google

the air-gap somewhat and thus increase the receiver efficiency, without appreciably increasing the danger of the diaphragm coming down on the pole face.

(*d*) As in transmitters, the air enclosed behind the diaphragm has a damping effect on the latter. By drilling a number of holes through the receiver case this damping effect is done away with. The result is an improvement in the reception of the order of 1 S.M., and this is a matter which appears worthy of further investigation.

The reception value of the Ericsson pattern hand micro-telephone instrument with the receiver fitted with 13–15 mil. metal spacing




2523

II.—Local Line Curve for No. 1 C.B. (Sending Allowances.)

ring is 2·3 S.M. with a ferrotype diaphragm and with a stalloy diaphragm 3·3 S.M.

Ageing of C.B. Receivers.—An investigation into the transmission ageing of twelve C.B. receivers which were in ordinary use over a period of two years has been carried out.

These receivers were temporarily recovered and tested every six months, and then put into service again. 10, curve A, shows the increase of allowance with age.

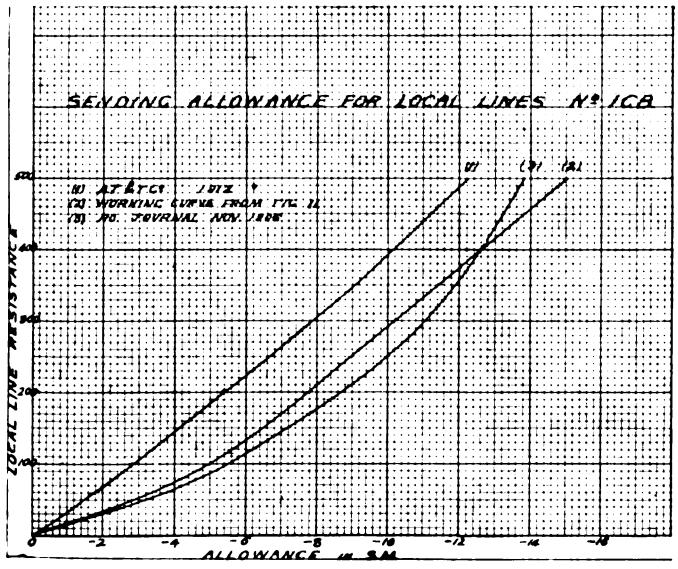
At the end of twenty-four months, after making transmission tests, the receiver caps were unscrewed for the first time since being put into service, and the particles of dust and magnetic filings which had collected on the pole-pieces brushed off. The receivers were then re-tested and curve B was thus obtained.



Digitized by Google

These curves indicate to what a considerable extent the transmission deterioration is due to the presence of particles on the pole pieces, and the result has been confirmed at other times when testing old receivers, both before and after cleaning. The nickelling of coil cheeks has been found to contribute to this trouble, as many flakes of nickel have been found attached to the pole-pieces. Curve B would appear to indicate the true ageing, probably mainly due to weakening of the permanent magnets.

LOCAL LINE ALLOWANCES.—The transmission allowances for subscribers' lines on C.B. systems depend on a considerable number of variables. The position two or three years ago was that a number of




2524

**12.**—COMPARISON OF VARIOUS LOCAL LINE CURVES. (SENDING ALLOWANCES.)

administrations had obtained curves for the allowances for the No. 1 C.B. system, introducing a number of these variables, but no allowances embodying all of them appeared to exist. As these allowances are of fundamental importance in standard cable measurements an elaborate investigation seeking to embody all the variables was carried out. It was soon established that the local line allowance curve is to a very great extent a characteristic curve for the telephone instrument used, as the variations caused by using different samples of the same type of instrument covered quite as considerable a range as the variation due to employing different types of local line. **11** shows the curve obtained for the sending allowances.

Each point on this curve with one or two exceptions represents the

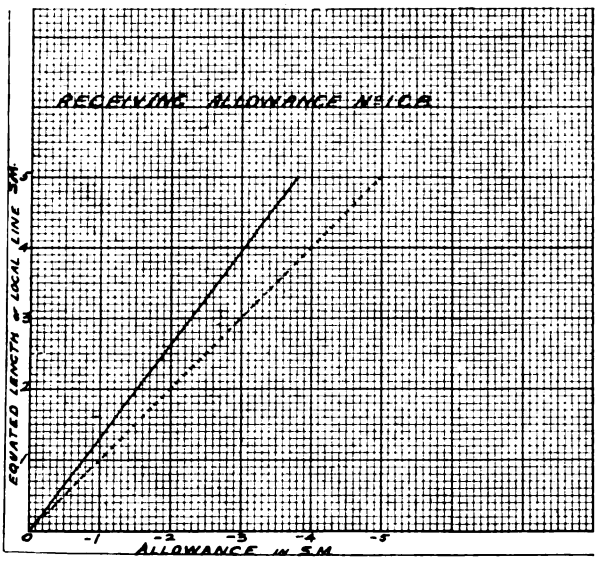


Digitized by Google

mean of six separate balances and there is a total of 364 balances. The variables taken into account are mentioned on this curve.

The mean curve which was adopted as a working sending allowance curve is illustrated again in **12**, for comparison with the latest determination by the American Telegraph & Telephone Company, and also the curve published in the 'P.O. Journal' of November, 1906.

The receiving curve for local lines is somewhat peculiar. Instead of being merely an equated length, deduced from the equivalent of the type of line employed, the actual allowance is less than this equated length. This, being interpreted, means that, within limits, the C.B. instrument becomes apparently more efficient when moved




2525

**13**.—Local Line Curve No. 1 C.B. (Receiving Allowances.)

some distance from the terminating repeating coil, due to a reduction in reflection effect; **13** illustrates this variation in receiving allowance.

Private Branch Exchange Allowances.—It is important to make due allowance for the losses occasioned by private branch exchanges, some of which give by no means inconsiderable losses.

One or two types which are much used may be referred to. The full lines in **14** show the talking circuit for a multiple type of private branch switchboard when an extension is speaking to the exchange. The sending allowance for this circuit is found as follows: Add to the combined resistance of the exchange and extension lines 66 ohms, to represent the resistance of the supervisory signals, and find the allowance for that total resistance from the local line curve. Then add — 2·7 S.M., which is an all round figure covering the shunt-



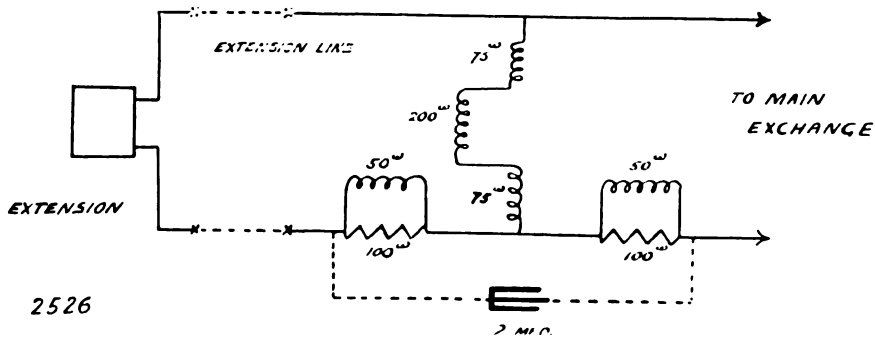
Digitized by Google

ing effect of the bridging retard, both on attenuation and on the current feed losses, and also the attenuation losses due to the signals.

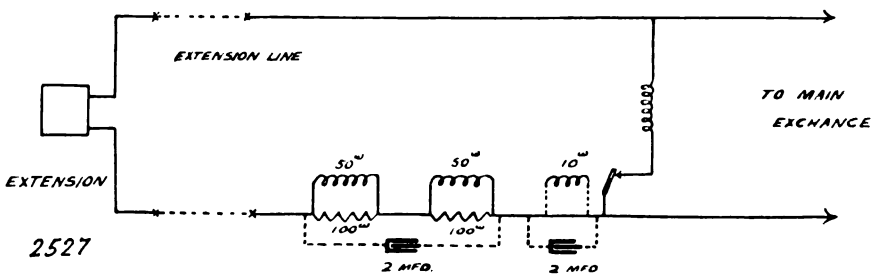
Now 66 ohms represents, at the middle part of the local line curve, about — 1·5 S.M. So that the sending allowance due to this switchboard is of the order of — 4 S.M.

The receiving allowance is — 1·7 S.M.

If, however, the signals are shunted by a 2 mfd. condenser the attenuation in them is rendered negligible, and the — 2·7 S.M. is reduced to — 1·7 S.M., thus effecting a material improvement in the




14.—Talking Circuit Multiple Type Private Branch Exchanges.




15.—Talking Circuit Non-Multiple Type Private Branch Exchanges.

sending allowance, and the receiving allowance becomes — 1 S.M. instead of — 1·7 S.M.

The full lines in **15** show the talking circuit for a non-multiple type of board.

Here, again, the sending and receiving allowances are identical with the allowances for the full line circuit in the previous case. If, however, the condenser and the relay indicated by dotted lines are fitted, the bridging retard is cut out whilst talking, and the allowance is obtained as follows; add the total resistance of the series apparatus, which amounts now to 76 ohms, to the total line resistance, and there will be no appreciable attenuation losses, as the bridging retard is cut off during conversation by the 10ω relay. The allowance



Digitized by Google

for 76 ohms at the middle part of the local line curve will be about — 1·8 S.M. For receiving, the additional attenuation effect due to the condenser shunted signals and relay is extremely small (about —0·2 S.M.).

These two P.B. exchange circuits are selected as typical examples. There are a number of other types, including some described in the latest edition of 'Connections of Telephonic Apparatus and Circuits,' which have somewhat higher allowances than the above. The importance of making due allowance for P.B. exchanges when considering the overall transmission must therefore be emphasised.

REFLECTION EFFECTS ON LOADED LINES.—A considerable amount

2528

**16.**—TERMINAL LOSSES ON LOADED LINES. NO. 1 C.B. TERMINATIONS WITH 25 c REPEATERS.

of experience has been obtained on the loading of junction lines of from about three to seventeen standard miles and mainly in cable. It is obvious that reflection effects play a very important part in the allowances for the shorter lines. Owing to the number of short lines which have been loaded it has been necessary to study reflection losses in much detail.

**16** shows a series of curves for reflection losses obtained by S.C. measurements for lines loaded to various characteristic impedances and terminated at both ends by C.B. local lines of various length.

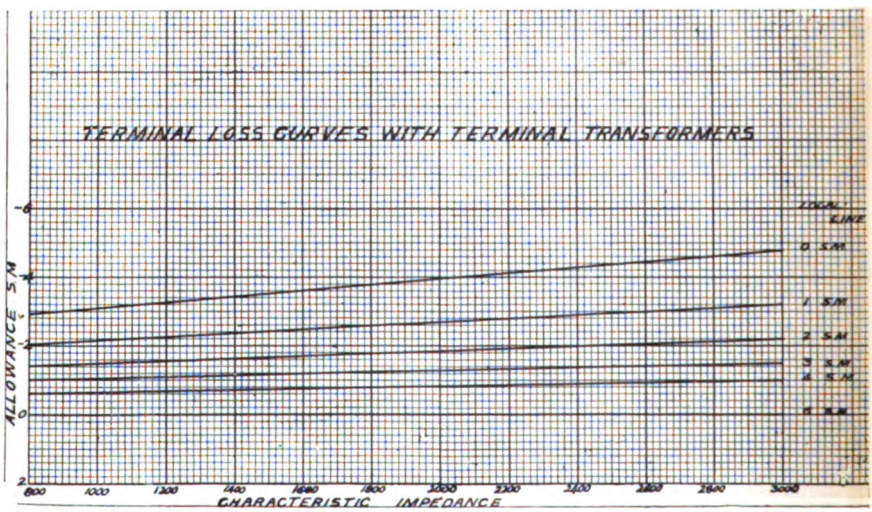
By adding the equated length of the loaded line, obtained by means of the usual attenuation formula, to the appropriate loss from these curves, the total allowance is arrived at. The reflection losses



Digitized by Google

are for both ends of the loaded line, and although, when considering one end, there is no doubt that the terminal effect varies according to the direction of travel of the speech-waves, this difference may be neglected for practical purposes. In considering, therefore, reflection losses for one end of a loaded line, half the allowance given in **16** can be taken. These values have been confirmed by S.C. measurements carried out on a considerable proportion of some 220 loaded junction lines.

USE OF TERMINAL TRANSFORMERS ON LOADED LINES.—Where a termination is the incoming end of a C.B. junction line it is possible to reduce the transmission losses to a very considerable




2529

**17**.—TERMINAL LOSSES ON LOADED LINES. NO. 1 C.B. TERMINATIONS WITH TERMINAL TRANSFORMERS.

extent by replacing the repeater by a terminal transformer. **17** shows curves giving the losses in such cases. It will be noted that under these conditions local lines of 6 S.M. give negligible reflection losses for lines of between 800 and 3000 ohms impedance.

When, however, a terminal transformer is fitted as an addition and close to an existing repeating coil, there is often a decided extra loss, and, at the best, no net gain. This appears to be due partly to interaction between the two coils, and partly to the additional core loss.

TRANSITION LOSSES.*—When two lines are joined together there will be a loss at the junction which will be proportionate to the ratio of the characteristic impedances of the two lines. In general

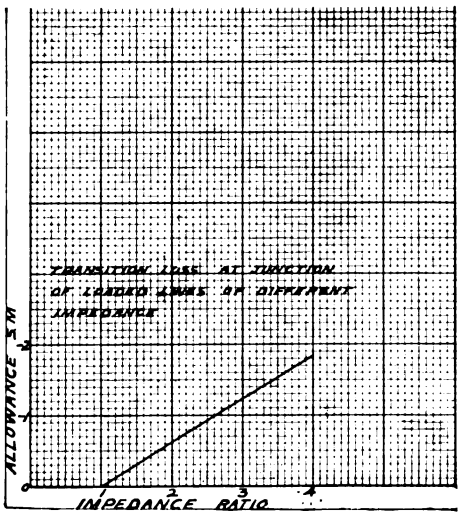
* See A. G. Lee, POST OFFICE ELECTRICAL ENGINEERS' JOURNAL, vol. 3, p. 318.



Digitized by Google

with unloaded lines these losses are comparatively unimportant, although there is evidence which indicates that more allowance should be made for this than has hitherto been done. When, however, the lines are loaded, the ratio of the characteristic impedances may be considerable, and when fairly long loaded lines are being considered it is necessary to make due allowance for this loss, which is here termed transition loss.

**18** gives values for this. This curve was obtained in the following manner: A number of combinations of differently loaded lines were tested when joined together and to various terminals, and the overall allowance obtained in both directions. The mean




2530

**18.**—Transition Losses on Loaded Lines.

values, plotted after subtracting the equated lengths of the line and the terminal allowances, give the losses shown in the curve.

It will be noted that, as a matter of convenience, the ratio of the higher to the lower impedance is plotted. For example a line of 800 ohms impedance, joined to one of 2400 ohms impedance, and with a consequent ratio of 3, would have a transition loss of about 1·25 S.M.

It will be observed that only the numerical part of the characteristic impedance is employed. This is all that is necessary, as lines loaded between the usual limits have in general very similar small negative angles for their characteristic impedance. It will also be noted that the losses are much smaller than would be inferred, judging by the curves in **16**. This is probably due to the fact that, in the case of **16**, the reflection loss is due to the difference

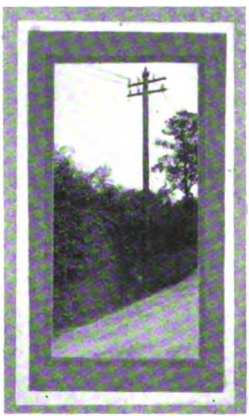


Digitized by Google

between the characteristic impedance of a loaded line and the impedance of a terminating instrument, so that there will be a large angular change, in addition to the change in the numerical part of the impedance value.

CONCLUSION.—An attempt has been made to define the scope of standard cable measurement and to indicate some of the more important precautions essential for obtaining accurate results.

Particulars of allowances are given for a number of different cases, such as instruments, circuits and lines. Many of these are the results of long-extended investigations, and it is hoped that they may be found of use to those engaged in elucidating transmission problems, which must become of increasing importance with the extension of telephone service.





Digitized by Google

# THE TELEPHONIC DEVELOPMENT OF THE BRITISH ISLES CONSIDERED IN RELATION TO THE POPULATION.

By W. H. GUNSTON.

THE publication of the preliminary figures of the census of 1911 furnishes an opportunity for ascertaining the present population of the telephone areas, and also for considering the proportion of telephones to inhabitants both of the British Isles as a whole and of the various telephone areas.

As the boundaries of these areas are in no case coterminous with any known geographical boundary (except in the case of Jersey, the Isle of Man and the Isle of Wight) it is not possible to ascertain the population of an area even approximately by a simple reference to the census returns. To obtain this information, therefore, as exactly as possible involved the compilation of a return which included the population of all boroughs and urban and rural districts within each area boundary together with the computed proportions of the population of those districts whose boundaries projected beyond the area boundary. Only thus is it possible to obtain a correct idea of the proportion of inhabitants to telephones.

Although the zone principle of trunk charges will tend to relax the fixity of area boundaries, the telephone area is useful as a unit for statistical purposes, for nothing could be more misleading than to take the population within a given city boundary as even roughly approximating the population of the area. Manchester, for instance, has a population of 714,000, whilst the area contains 1,200,000 inhabitants. To consider the city population, therefore, in proportion to the official number of telephones in Manchester would be unduly flattering to telephone development. If we take a more favourable case, the Newcastle-Gateshead area, and add the popula-



Digitized by Google

tion of these two places together, viz. 383,000, we still obtain only about one half the population of the area. A striking case is Chesterfield. That town only contains 37,000 out of the 167,000 inhabitants of the area.

The following table shows the development of those areas containing over 5000 telephone stations. It should be mentioned that the figures for Dublin and Belfast are only roughly approximate, as the Irish preliminary census is not so detailed as that for England and Scotland.

*Table showing the Population, Number of Telephones, and Population per Telephone in Areas containing* 5000 *Telephones and over.*

| | Population of area. | Total number of telephones in area, December 31st, 1911. | Population per telephone. |
|---|---|---|---|
| Hull | 314,500 | 12,082 | 26 |
| Glasgow | 1,170,000 | 40,609 | 28 |
| Brighton | 218,700 | 6,792 | 32·2 |
| London | 7,160,000 | 211,341 | 33·8 |
| Cardiff | 276,200 | 7,077 | 39 |
| Edinburgh | 507,300 | 12,750 | 39·8 |
| Liverpool | 1,141,000 | 27,995 | 40·7 |
| Portsmouth | 311,000 | 7,540 | 41 |
| Bradford | 468,600 | 10,089 | 46 |
| Manchester | 1,233,000 | 25,897 | 47 |
| Bristol | 433,500 | 7,330 | 59 |
| Leeds | 578,000 | 9,804 | 59 |
| Nottingham | 460,000 | 7,652 | 60 |
| Belfast | 470,000 | 7,286 | 64 |
| Newcastle-on-Tyne | 640,000 | 9,996 | 64 |
| Dublin | 450,000 | 6,951 | 65 |
| Sheffield | 700,000 | 9,755 | 71·7 |
| Birmingham | 1,125,000 | 15,713 | 72 |

The telephone stations in this and in the succeeding tables include those belonging to the systems of the late National Telephone Company, the Post Office and the various municipal undertakings.

The next table shows those areas in England and Wales with not more than 60 inhabitants per telephone.

*Table showing Areas in England and Wales with not more than Sixty Inhabitants per Telephone.*

| Area. | Population per telephone. | Area. | Population per telephone |
|---|---|---|---|
| Hull | 26 | Eastbourne | 37 |
| Brighton | 32 | Hexham | 37 |
| London | 34 | Cardiff | 39 |



Digitized by Google

| Area. | Population per telephone. | Area. | Population per telephone. |
|---|---|---|---|
| Harrogate | 39 | Blackpool | 53 |
| Liverpool | 40 | Watford | 55 |
| Llandudno | 40 | Folkestone | 55 |
| Portsmouth | 41 | Hastings. | 57 |
| Llandrindod | 42 | Sevenoaks | 58 |
| Jersey. | 44 | Bristol | 59 |
| Buxton | 45 | Haslemere | 59 |
| Bradford | 46 | Halesworth (Southwold) | 59 |
| Newbury | 46 | Reading | 59 |
| Tunbridge Wells | 46 | Ramsgate | 59 |
| Manchester | 47 | Scarborough | 59 |
| Chertsey | 48 | Middlewich | 59 |
| Cambridge | 48 | Nottingham | 60 |
| Ormskirk | 48 | Leicester. | 60 |
| Bournemouth | 49 | Huddersfield | 60 |
| Walton-on-Naze | 50 | | |
| Swansea | 52 | | |

It will be seen that the best developed areas are those containing (*a*) towns where there has been competition, such as Hull, Brighton and London; (*b*) large cities with commercial, manufacturing and residential population, such as Liverpool, Manchester and Bradford; (*c*) pleasure resorts where the population is fairly dense, such as Eastbourne and Harrogate.

It is of interest to compare the development of the British Isles at the present time with that of 1901. The increase in telephone stations from 196,000 to nearly 652,000 shows that very considerable progress has been made, and the proportion of population to telephones exhibits a correspondingly satisfactory decrease. Scotland comes out as the best developed of the three kingdoms in both years.

*Table comparing Development in* 1901 *and* 1911.

| | Population, 1901 (hundreds). | Telephone stations, Dec. 31st, 1901. | Population per telephone, 1901. | Population, 1911 (hundreds). | Telephone stations, Dec. 31st, 1911. | Population per telephone, 1911. |
|---|---|---|---|---|---|---|
| England and Wales | 32,527·8 | 159,936 | 203 | 36,075·2 | 551,633 | 65 |
| Scotland | 4,472·1 | 27,713 | 161 | 4,759·4 | 82,721 | 58 |
| Ireland | 4,458·8 | 7,204 | 619 | 4,381·9 | 13,619 | 322 |
| Islands in British Seas | 150·3 | 1,299 | 116 | 148·9 | 3,963 | 38 |
| British Isles | 41,609·0 | 196,152 | 212 | 45,365·6 | 651,936 | 70 |



Digitized by Google

Glasgow and Tunbridge Wells were the only two municipalities operating telephones in 1901, and possessed about 2000 stations between them. The Post Office system then comprised only 2686 provincial stations, the London system not having been inaugurated. In 1911 the only municipal systems extant were those of Hull, Portsmouth, and Guernsey. The 651,936 stations in the British Isles in that year consisted of 525,440 belonging to the National Telephone Company, 118,995 to the Post Office, and 7501 to the corporations. The latter figure, however, refers to the end of March while the two former relate to the end of December.

| | Population, 1901 (hundreds). | Telephone stations, 1901. | Population per telephone, 1901. | Population, 1911 (hundreds). | Telephone stations, 1911. | Population per telephone, 1911. |
|---|---|---|---|---|---|---|
| London . . . . | 6,540 | 39,516 | 167 | 7,160 | 211,341 | 33 |
| Glasgow . . . . | 1,032 | 12,129 | 85 | 1,170 | 40,609 | 28 |
| Liverpool . . . . | 1,020 | 14,020 | 73 | 1,141 | 27,995 | 40 |
| Manchester . . . | 1,120 | 10,372 | 108 | 1,233 | 25,897 | 47 |
| Birmingham . . . | 920 | 6,179 | 149 | 1,125 | 15,713 | 72 |

The development of these areas during the decade shows some remarkable progress. In London the telephone system has increased more than fivefold, in Glasgow more than threefold, in Liverpool twofold, while in Birmingham and Manchester the number of telephones is now nearly two and a half times as great as in 1901.

The high development of Liverpool in 1901 is noticeable, taking into consideration that no competition existed in that city. In Glasgow the Corporation system was well under way, but in the other areas the Company had the field to itself. The satisfactory improvement of London's position in 1911 has, of course, been greatly assisted by the establishment of a Post Office system which owned at the end of that year more than one third of the stations. Glasgow, however, now occupies the best position on the list, a result of fierce competition, Liverpool falling to third place.

The last table is designed to show the development of the largest centres of population considered in a wider sense than that of the area boundaries. London (which has been included because it includes a complete county and a large part of five others) occupies the best position on the list, closely followed by a group of the Home Counties. These (which also include London) are a good second, despite the inclusion in their area of thinly populated rural tracts in parts of Essex, Herts and Sussex. The poor results shown by Northumberland and Durham are doubtless due to the large proportion of miners in the total population, and the same applies to a certain extent to South Wales and the Black Country. Yorkshire runs Lancashire



Digitized by Google

very close, and this, considering the rural character of much of the North and East Ridings, and the large tracts of moorland in the north west, is very creditable.

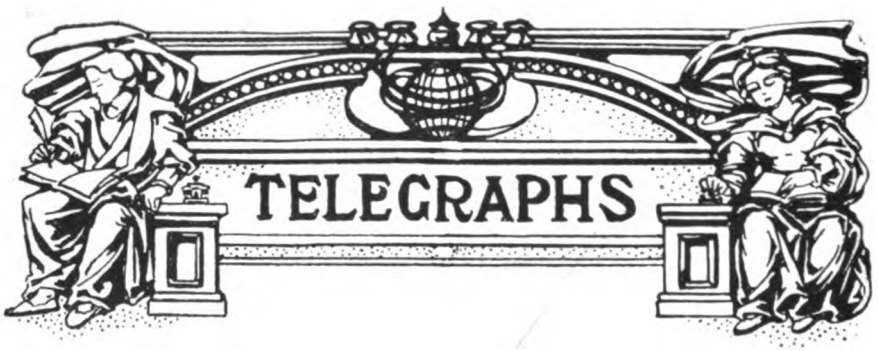
| Name of district. | Description of district. | No. of stations. | Population, thousands | Population per station. |
|---|---|---|---|---|
| London | Telephone area | 211,341 | 7,160 | 33·8 |
| Essex, Herts, London, Middlesex, Surrey, Kent, and Sussex | Administrative counties | 243,850 | 9,866 | 40 |
| Lancashire and Cheshire | ,, ,, | 86,640 | 5,723 | 66 |
| Yorkshire | Administrative county | 56,546 | 3,980 | 70 |
| Black Country | Telephone areas of Birmingham, Dudley, Wolverhampton, and Walsall | 19,757 | 1,737 | 88 |
| South Wales (including Monmouth) | Administrative counties of Glamorgan, Carmarthen, Pembroke, Brecknock, and Monmouth | 19,722 | 1,826 | 93 |
| Northumberland and Durham | Administrative counties | 19,000 | 2,067 | 109 |

In presenting these figures it is not desired to make any odious comparisons, for it is probable that the cases of less satisfactory development all have their due explanation, but rather to place on record some statistics which, it is hoped, may be found useful for reference.

CAPITOL, WASHINGTON.



Digitized by Google




## EARLY DAY OF TELEGRAPHY.

AMIDST the world-wide interest recently aroused by Sir E. Grey's epoch-marking speech, which appeared practically verbatim in the newspapers placed upon our breakfast tables, how many of their readers gave a passing thought to the heavy strain thrown upon telegraphists and the press representatives to allow of this being done? The requisite elaborate circuit arrangements and perfection of apparatus enabling news to be transmitted from 200 to 500 words per minute compares so widely with the early days of telegraphy that probably a few contrasts may prove of interest to your readers. Compare London and Aberdeen—540 miles apart—working on this occasion at the present-day rate with the following record between Dover and London:

"On the 11th of December, 1849, to the great astonishment of the merchants and bankers at Paris, three gentlemen appeared on change in that City at 1.30 p.m., having with them 150 copies of 'The Times' printed and published in London on the morning of the self same day, and not only did 'The Times' contain the Paris news up to *noon* of the previous day, but actually the closing prices of the Paris Bourse of the *previous evening*.

"The electric telegraph contributed in no small degree towards the accomplishment of this feat. At 1.8 a.m. the despatch of 321 words and the Bourse prices—of 55 words—was received at Dover from Calais by mail boat. At 1.40 a.m. a correct copy of each was handed in by us at 'The Times' office in London. The despatch occupied eighteen minutes, being at the rate of $17\frac{5}{6}$ words per minute, the Bourse prices two minutes only, as the larger portion is anticipated, the mere fluctuations being all that is new. There was nothing extraordinary in this, quickly as it was accomplished, there being *two* clerks on duty at *London* (South Eastern Railway), one to read and the other to write."



Digitized by Google

Several other instances are given of rapid (?) working, averaging from 13½ words to 20⅕ words per minute.

The rates charged for telegrams of 20 words at that date, if applied to the present-day numbers, would cause the Post Office Telegraph authorities to rub their hands joyfully as they gathered in the shekels.

| | s. | d. |
|---|---|---|
| London to Birmingham (72, Canal Street) . . | 6 | 6 |
| ,, ,, Derby (Railway Station) . . . | 7 | 0 |
| ,, ,, Edinburgh (68, Princes Street) . . | 13 | 0 |
| ,, ,, Glasgow (Exchange Square) . . | 14 | 0 |
| ,, ,, Leeds (Commercial Buildings) . . | 8 | 6 |
| ,, ,, Liverpool (Exchange Buildings) . . | 8 | 6 |
| ,, ,, Manchester (The Arcade) . . . | 8 | 6 |
| ,, ,, Newcastle-on-Tyne (Sandhill) . . | 10 | 6 |

Charge for messengers 1*s.* per mile.

Staff advances might be relied upon with such returns—surpluses instead of deficits.

Coming to dates a little later we have the struggles of the London District Company, incorporated in 1858, for the delivery, in London only, of ten-word telegrams at fourpence per message, soon increased to fifteen words for sixpence, without success.

The United Kingdom Telegraph Company, Limited, in 1861 endeavoured to introduce a low uniform charge throughout the country. To raise the necessary capital the company issued either ordinary shares or bonds bearing 7½ per cent. interest per annum, payable half yearly, in advance, in frank message stamps; thus for each £100 bond the bond-holder was entitled to send seven pounds ten shillingsworth of messages per annum. For instance, in Hull just £4000 was subscribed by sixty leading merchants, brokers, etc., who used the telegraph. For four years the company persistently sought to maintain this rate, but at the termination of this period circumstances compelled them to depart from the basis chosen and adopt that of a tariff graduated by distance.

And now what of the old E. & I. T. Co.?

This was plodding along its weary way, as were its old operators, and as one associated with that more successful company I thought a few original works orders might recall to others their earlier efforts and the changes which occurred.

*May 4th*, 1861. *E.O.* 3523.—"Re-insulating the Nottingham and London printing circuit between Long Eaton and Syston on wooden insulators (17 miles)"! How the Tangent Galvos glass eye would shine, and rouse the needle's sluggish movements.

*April 7th*, 1862. *E.O.* 1645.—"Removing the double needle at present fixed at Nottingham Town intermediate (in a loop) and transferring same to the Mansfield and Nottingham Railway circuit." What consternation a back view of the old double needle might create in the Nottingham office to-day should the feminine section mistake



Digitized by Google

it as a hat box for "Merry Widow Straws," the delicate outlines of which are more fully appreciated when, sitting behind one on the Sabbath, with half the church hid from view, you hear the parson's voice over its edges referring to the "things present" and the "more awful things to come."

*August 30th*, 1862. *E. O.* 1509.—Derby Town Extension.

(A) Erecting six wires on present poles. Derby Station and Junction for town (Cattle Dock).

(B) Erecting ten wires on new poles between Cattle Dock and Derby Town.

Extending Derby (Station) and London single-needle circuit to Derby Town.

Looping the London–Derby Station and Sheffield printing circuit to Derby Town.

Looping the London–Nottingham–Derby Station and Birmingham printing circuit to Derby Town, etc., etc., resulting in Derby Town being provided with two printing circuits, three single-needle and one double-needle instruments.

**1** is a photo of the last-named instrument.

*August 29th*, 1862. *E. O.* 1503.—Extending the Masbro-Sheffield Double-Needle Railway circuit from Sheffield (M. S. & L.) to Sheffield (Town) by wires at present spare, and fixing a double-needle thereon. (Answer that call, Daniel!)

*February 4th*, 1863. *E. O.* 1607.—Leicester Town Extension (No. 1, Millstone Lane). Erecting four wires on new poles over the house tops from the nearest point on the line of railway to the new Town office, employing two of them to form a loop on the London–Nottingham printing Commercial circuit, transferring the printer at Station Office to the Town office, employing the other two wires to loop in on the Birmingham and Rugby *viâ* Derby single-needle circuit.

What patience Miss Louie Yates at "LY." extended to us youngsters whilst learning?

*September 25th*, 1863. *E. O.* 1752.—Nottingham Town had double needle provided by a loop in Boston and Nottingham Railway Station circuit. (Give "MQ," Thomas, with the Patriarchal Patch.)

*April 12th*, 1864. *No.* 1957, *F.*—A circuit running London to Sheffield *viâ* Peterborough (G. N.) and Syston (M. R.), shortened by running new wire Hitchin (M. R.) to Syston (M. R.); also the circuit extended from Sheffield (Town) to Leeds (Town) forming new LY-Leeds circuit.

*May 30th*, 1864. *E. O.* 1993, *F.*—Fixing a switch at Derby Town to put Sheffield through to London (*viâ* Nottingham) and Birmingham through to London direct when required (!)

*July 6th*, 1865. *E. O.* 6549.—Supply Sheffield–Leicester and Nottingham Town Office with one Morse instrument each as spare. (Lavish waste!)

The Millstone Lane Office, Leicester, was a model one. Hours 8 a.m to 8 p.m., no break, one clerk, Joint C.-in-C. and messengers with railway station office. Counter room led to instrument room, to enter which a string was pulled to lift latch inside. Printer on table under window. Small form for two messengers. Large coal (*versus* punishment) box capable of holding one ton coal and an unlucky messenger. Battery rack in far corner with its grim row of Daniell 12 plates.

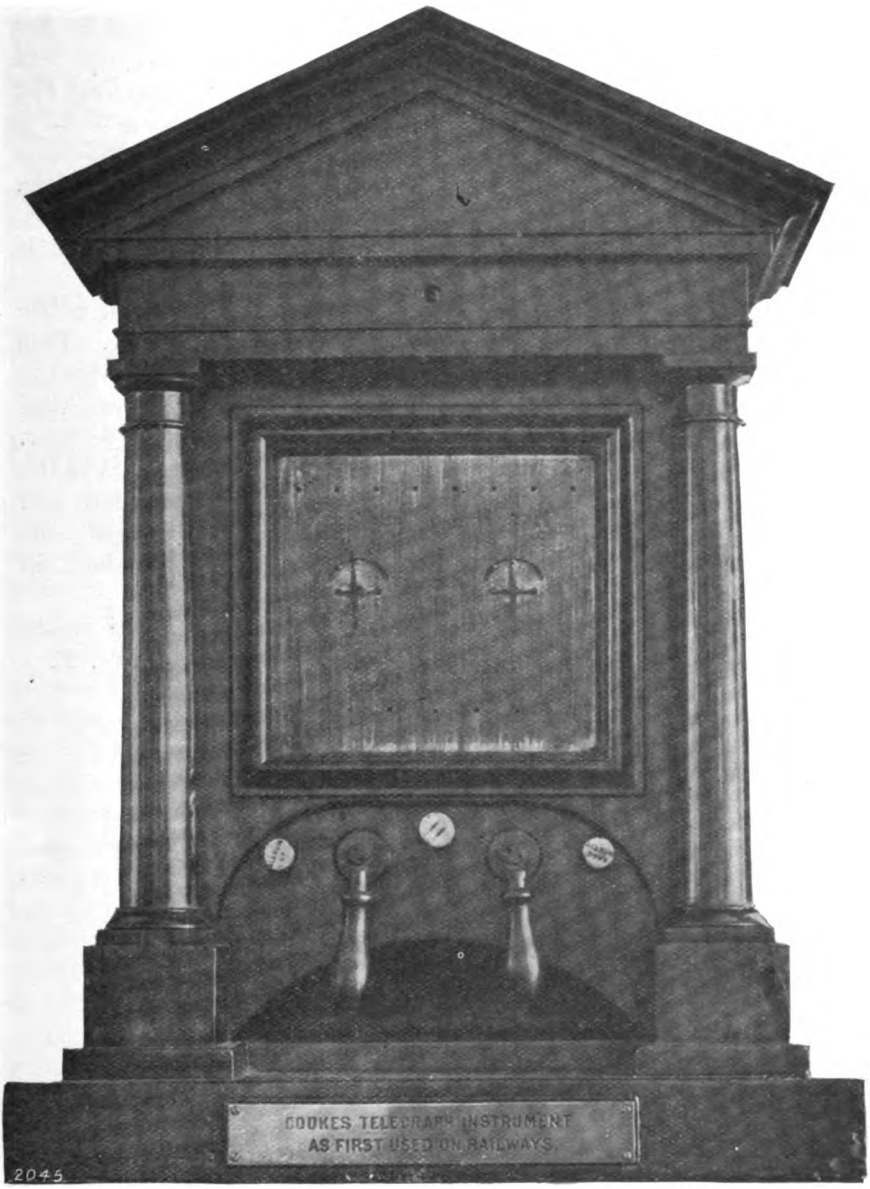
The Birmingham and Rugby *viâ* Derby single-needle circuit with switch at Rugby to put you through to London—when possible to read the feeble oscillations of the needle.

The linemen in those days were workers and prepared for any emergency. Ladder, draw-vice, and wire, with a "top hat" tool chest, taped inside for the reception of gimlet, bradawl and small screwdriver. The accompanying photo (see Frontispiece) is enlarged



Digitized by Google

from one taken of an old "Brummagem" lineman as he appeared on duty, top hats being then emblematic of such important positions, including policemen, etc., also an occasional C.-in-C.




I.—Photograph of Double-Needle Instrument Fitted at Derby in 1862.

An American writer (1849) explains that at intermediate stations the operator was called upon to remove faults. If stations fifty miles apart, he was held responsible for twenty-five miles each side



Digitized by Google

of the office. Immediately on appearance of fault he prepared his tools and proceeded on horse-back to discover same. The details conclude as follows:

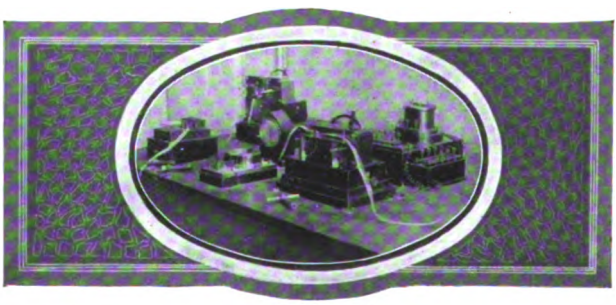
"While others are seated comfortably around the fireside the operator has to traverse forest and wild regions in rain, snow and hail. Through the cold chilling blast he wends his way along the wire thread. Solitary and alone he thus nobly performs his task."

I should imagine so, and at the present time there would be a few smiles and titters on the part of those watching his departure, also a slight grimace on his own.

The following extract *re* the jointing of overhead lines is unique:

"Some lines are built without soldering the joints. In a few years they worked better during and after rain than when dry. This resulted from water resting in the cavities of joints. When dry the rust was an indifferent conductor. Even the dews of Heaven that fell during the night served as rich blessings to the wearied operator. It seemed to me that the finger of the Creator benignly aided in the perfection of the means for the transmission of that mysterious and imponderable agent which conceals itself and nestles in the gorgeous drapery of his throne, a power in nature so transcendent in sublimity that it can have no twin."

I calculate a twin wasn't wanted if a rusted joint could create such a flow of oratory. J. W. F.





Digitized by Google

# POWER PLANT FOR MODERATE RANGE WIRELESS STATIONS.

By J. Coxon, A.M.I.E.E.

The development of wireless telegraphy has long since passed the stage when a battery of primary cells and an induction coil formed the means of obtaining the necessary high voltage energy, except for very short range stations, and it has been suggested that the consideration and description of the power requirements for modern stations may be of value to some readers of our Journal.

In a spark system of wireless telegraphy the function of the power plant is usually to supply alternating current at a high voltage for charging condensers, and 1 shows diagrammatically the arrangement adopted. The motor is generally supplied with direct current, and is direct coupled to a generator supplying alternating current through a suitable "keying" device and choke coil, to a "step up" transformer, the secondary of which is connected either across the spark gap or condenser. The discharge from this condenser passes through the spark gap and primary winding of the oscillation transformer, and from the secondary of this the high-frequency energy is communicated to the aërial and radiated into space. 2 shows a photo of the actual apparatus numbered to correspond with 1.

The amount of power to be employed in a wireless station for a given range is not yet deducible from any known formulæ, and the transmission is affected by various factors, such as:

(1) The location of the station.

(2) Whether the transmission is over sea or land.

(3) Atmospheric disturbances or perturbations, and the effect of daylight.

(4) The size and type of the antennæ, both of the sending and receiving stations.

(5) The spark frequency to be adopted.



Digitized by Google

(6) The speed of signalling.
(7) The system to be adopted.
The following table has been prepared by the Marconi Company

*Approximate Range of Wireless Stations and Power required.*

| Power. | Range in nautical miles. | | | | Wave length (metres). |
|---|---|---|---|---|---|
| | Over sea. | Over land. | | | |
| | | Flat. | Hilly, 500 ft. | Mountainous, 3000 ft. | |
| 300 watts. | 100 | 77 | 30 | 13 | 300 |
| | 100 | 95 | 73 | 52 | 1200 |
| 1½ k.w. | 220 | 170 | 67 | 28 | 300 |
| | 220 | 210 | 160 | 115 | 1200 |
| 3 k.w. | 280 | 240 | 140 | 80 | 600 |
| | 280 | 270 | 200 | 145 | 1200 |
| 5 k.w. | 340 | 290 | 175 | 100 | 600 |
| | 340 | 325 | 240 | 175 | 1200 |
| 10 k.w. | 470 | 400 | 240 | 135 | 600 |
| | 470 | 450 | 330 | 240 | 1200 |

The powers given refer to the output of the alternator, and is the power available for charging the condenser (plus the transformer and choke coil losses). For a given condenser the power required = $2n\,(\frac{1}{2}\,KV^2)$ joules per second,
where $n$ = the frequency of the alternator in cycles per second,
K = the capacity of the condenser in farads,
V = the voltage at which the spark gap breaks down (= "peak" voltage of AC × 1·57).
Then, as 1 joule per second is 1 watt, we have—

$$\text{Power in k.w.} = \frac{nKV^2}{1000}.$$

For each half cycle of the alternating current we thus get one charge and an oscillatory discharge of the condenser, and although this may take place more than once when using a plain spark gap or a short one, effort is made in modern stations to avoid this by the employment of a disc discharger.

This appliance as made by the Marconi Company and seen in **2**, consists of a disc, generally direct coupled to, but insulated from, the shaft of the alternator. The periphery of the disc is fitted either radially or transversely with copper studs, corresponding in number to the number of poles in the alternator. Two fixed electrodes, insulated from the case and each other, but rotatable about the axis of the disc, are connected in the primary oscillating circuit, and adjusted

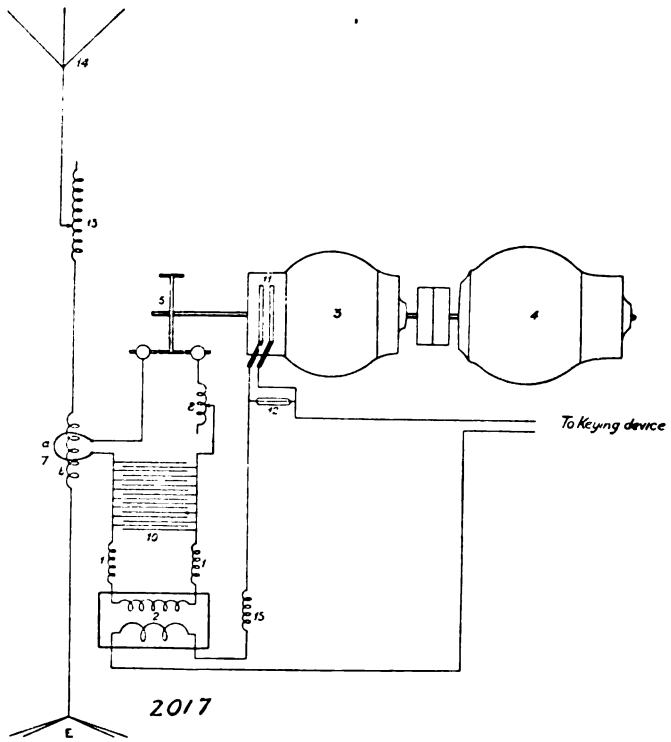


Digitized by Google

so that they are practically short-circuited at the instant the condenser discharges, the spark starting as the studs are approaching alignment. The action of this appliance has the effect of considerably improving the efficiency of the spark system —

(1) By reducing the resistance of the gap.

(2) By opening the primary circuit the oscillations in this circuit are rapidly damped out, thus leaving the secondary and aërial




I.—Diagrammatic Arrangement of Power Wireless Station.

1. High-frequency chokes. 2. Transformer. 3. Alternator. 4. D.C. Motor. 5. Disc discharger. 6. Switchboard (see 2 only). 7. Oscillation transformer: *a*. Primary; *b*. Secondary. 8. Primary tuning inductance. 9. Swiss commutator (see 2 only). 10. Condensers. 11. Alternator slip rings. 12. Guard lamp. 13. Aërial tuning inductance. 14. Aërial. 15. Primary choke coil.

circuit free to oscillate without interference by the reactance of the two coils.

(3) By the prevention of arcing at the gaps, thus enabling larger powers to be employed.

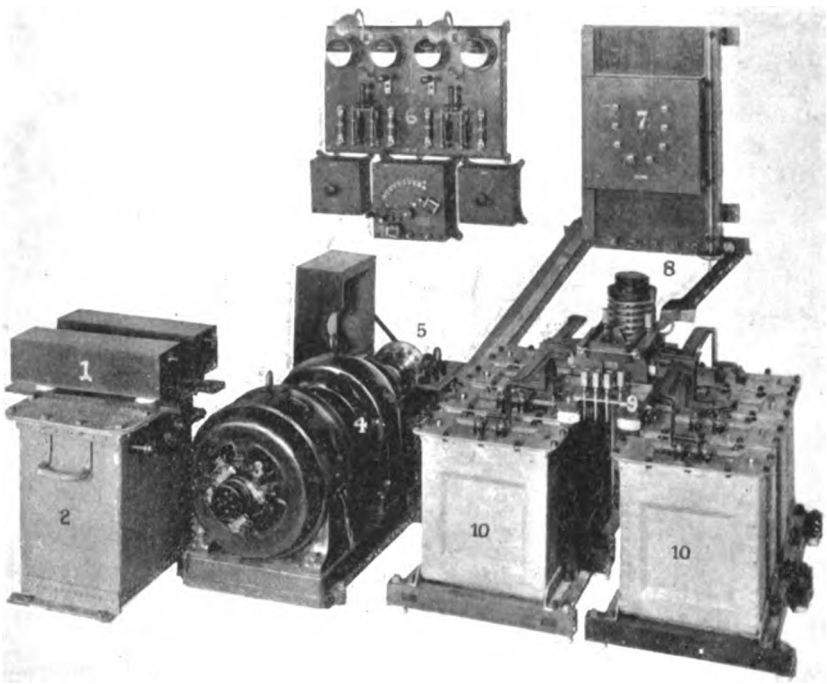
(4) By using an alternator of sufficiently high frequency a musical note, corresponding to double the frequency, is obtained which facilitates the reading of the signals at the receiving station, the tone being distinct from that caused by atmospheric disturbances.



Digitized by Google

3 shows diagrammatically the arrangement of the discharger, and 4 the action during each half-cycle of the alternator.

TRANSFORMERS.—The transformers used for wireless purposes are usually of the closed magnetic circuit type with independent windings, the whole being insulated and cooled by immersion in oil. The ratio of the windings and the secondary voltage varies with the supply voltage and the capacity of the condenser to be employed.




2.—PHOTO OF 5 K.W. PLANT.

An earthed shield is desirable between the high and low tension windings for safety. The high tension leads are brought out of the oil tanks through heavy porcelain or ebonite insulators preferably to a safety spark gap of such a width as will prevent damage to the windings by high tension surges. The self-induction and resistance of the primary winding should be kept as low as possible.

The transformer should satisfactorily withstand the following tests :

(1) The transformer to be worked at full load output for a period sufficiently long to enable the transformer to attain such a tempera-

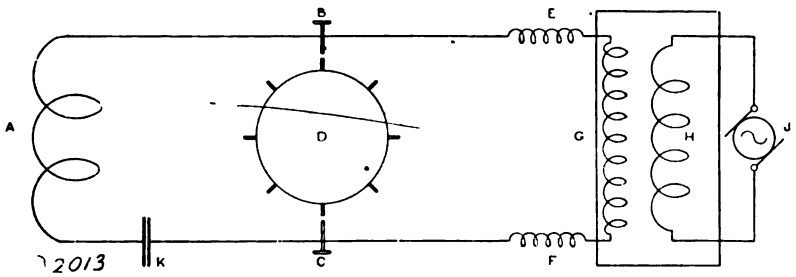


Digitized by Google

ture that the increase of temperature does not exceed 1° C. per hour. The temperature rise of the hottest part is then not to exceed 50° C. as measured by the rise in resistance.

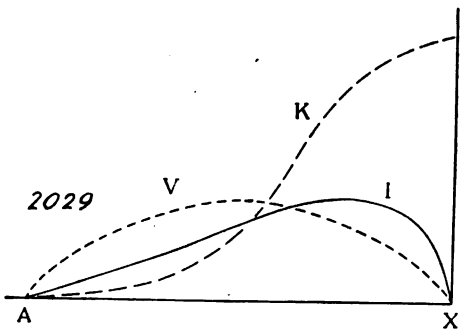
(2) The insulation of the HT windings while hot, tappings and terminals should withstand an AC pressure (RMS volts) of at least twice the working pressure.

The insulation of the low-tension windings, tappings and terminals to withstand 2000 volts (RMS value) for five minutes




**3.**—Arrangement of Disc Discharger.

A. Primary of oscillation transformer. B C. Fixed electrodes. D. Disc. E F. Protective chokes. G. Transformer, secondary. H. Transformer, primary. J. Alternator.




**4.**—Action of Disc during each Half Cycle of Alternator.

V. Alternator voltage. I. Current flowing into condenser. K. Condenser volts. The condenser discharges at time X (A–X = ½ period).

between the windings, and the core, case and earth shield connected together.

(3) The efficiency at unity power factor should be not less than 92 to 95 per cent. at full load, and 85 to 90 per cent. at half load.

(4) The open circuit losses should be not more than 1 per cent.

(5) The ratio of transformation should be as specified.

(6) The pressure drop at full load should not exceed 3 per cent.

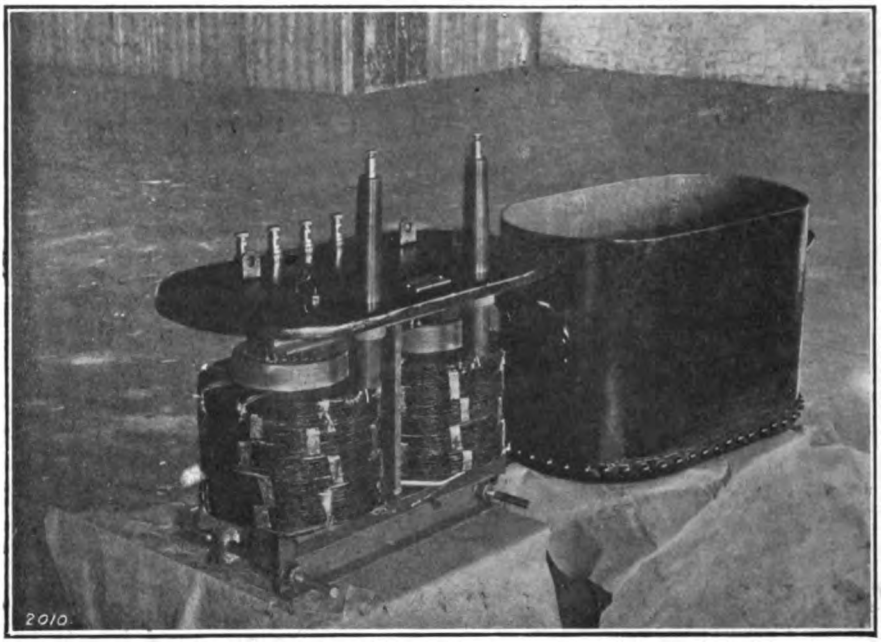
(7) The transformer should also be subjected to switching tests.

The action of a transformer supplying energy to a bank of con-



Digitized by Google

densers for wireless working presents many interesting points, and frequently it is only by investigation with the aid of an oscillograph that the exact state of affairs can be ascertained. The low-frequency circuit should be designed to be in resonance, and the mutual inductance between the primary and secondary windings and the ratio of transformation are important factors in this respect. The properties of transformers for wireless working require to be quite different to those for power and lighting purposes. The latter type will supply increasing power as the resistance of the load decreases, while with the former, the passage of the spark is equivalent to a short circuit,




5.—Wilson Transformer.

and it is necessary to limit the rise of current when this occurs to prevent arcing. With a closed core transformer this condition is attained by the insertion of a suitable iron core choking coil, either in the primary or secondary circuit, or by a series resistance. The former is the usual and more economical method, and the arrangement is seen in 1.

Protective Choke Coils.—Between the secondary windings and the high-frequency circuit it is necessary to fit suitable choking coils in order to prevent the high-frequency currents from entering the transformer windings and breaking down the insulation (see 1).

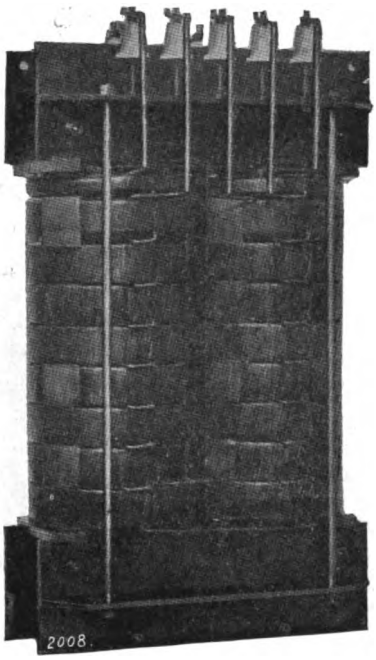
5 shows a transformer (removed from the oil tank), as made by the



Digitized by Google

Wilson Apparatus Company of Carlisle. These transformers are specially designed for wireless working by Mr. W. H. Wilson, and for a given output occupy the minimum amount of space. The core type of construction is employed for sizes of 1 k.w. and upwards, and is immersed in oil for insulating and cooling. In the smaller air-cooled sizes, where lightness is of importance, they are of the "shell" type, as this construction affords better protection to the windings, besides conducing to lightness.

In both types the limb on which the winding is placed is built up




6.—Johnson and Phillips' Transformer.

to an approximately circular section, which gives a secondary of the lowest possible resistance.

The secondary winding is the chief feature, and consists of a large number of flat helical sections, separated by insulating washers. The conductor consists of high-conductivity copper strip, insulated in large transformers with cotton, and in very small transformers with silk.

Each section has the same width as the strip, the turns being wound one on the top of the other; this ensures that the insulation between the turns has to withstand the pressure due to one turn only.

The sections are connected without joints in the conductor by carrying the strip radially inwards, between insulating washers, from



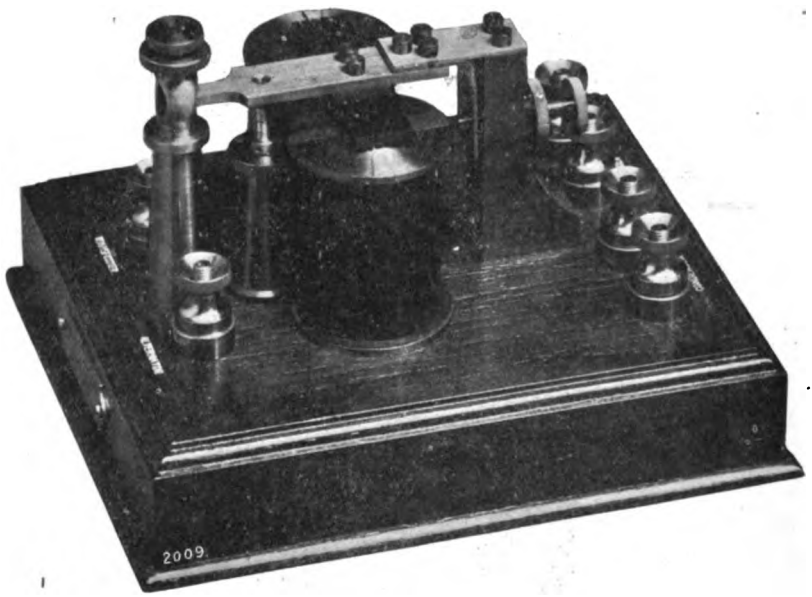
Digitized by Google

the finish of one section to the start of the next, the strip being turned on its flat so as to occupy little space.

The turns in each section are fixed at such a number that the voltage per section does not exceed 150 volts, and as the sections are cross-connected the separating washers are only stressed to the pressure generated in one section.

The method gives the smallest possible dimensions for the secondary winding with a given factor of safety, while the secondary resistance is low.

The insulation between turns and between sections at each end of the winding is reinforced to give protection against surges.




7.—Single Marconi Magnetic Key.

A very high factor of safety for a given amount of insulation material is secured, the transformers thus occupying little space and having relatively low secondary resistances.

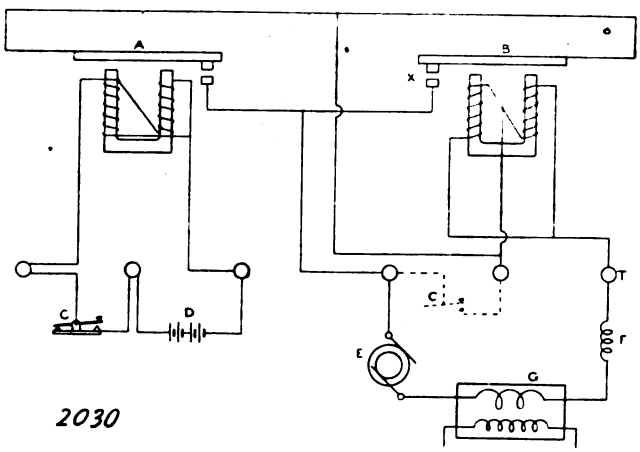
6 shows a type of transformer, also removed from the oil tank, which is much used in wireless stations, and which is made by Messrs. Johnson and Phillips, of Charlton, Kent. In this transformer the core is built up of sheets of the best quality transformer iron which contains a small proportion of silicon and reduces the hysteresis and eddy current losses to a minimum. In the larger sizes the construction is of the "butt joint" type, and in the smaller sizes the core and yoke sheets are interleaved and clamped together by means of wrought iron plates. Each successive sheet of the core is insulated by a special process, and the whole compressed and baked



Digitized by Google

to form a solid mass held together by brass bolts. The clamping bolts through the parts carrying the flux are few in the large sizes, and these are carefully insulated. In the small sizes there are no bolts through the core.

The high and low tension coils are wound of high conductivity copper. The low tension usually consists of laminated strip insulated with specially prepared material and then varnished over all. The high tension consists of cotton-covered wire, the successive layers being insulated from each other by sheets of insulating material of the best quality. The whole coil is then thoroughly dried in a vacuum, impregnated whilst under vacuum with the best quality of varnish procurable, and then baked. By this means the




8.—Diagram of Marconi Double Magnetic Key.

whole of the space between the successive turns and layers of wire is filled up solid with varnish, and breakdowns are almost impossible.

The low-tension terminals up to 600 volts are mounted on insulating washers and bushes. The high-tension terminals are mounted on porcelain, the thickness and creeping surface of which depend upon the voltage. For very high voltages special arrangements are made.

Oil-cooled Type.—Plain tanks are supplied in the small sizes of galvanised wrought iron. For sizes over 50 k.w. the tanks are provided with external corrugations to give a large radiating surface. A tap is fitted by means of which the oil can be drawn off when necessary. If required an oil gauge can also be fitted. Channel iron feet or wheels can also be provided when necessary.

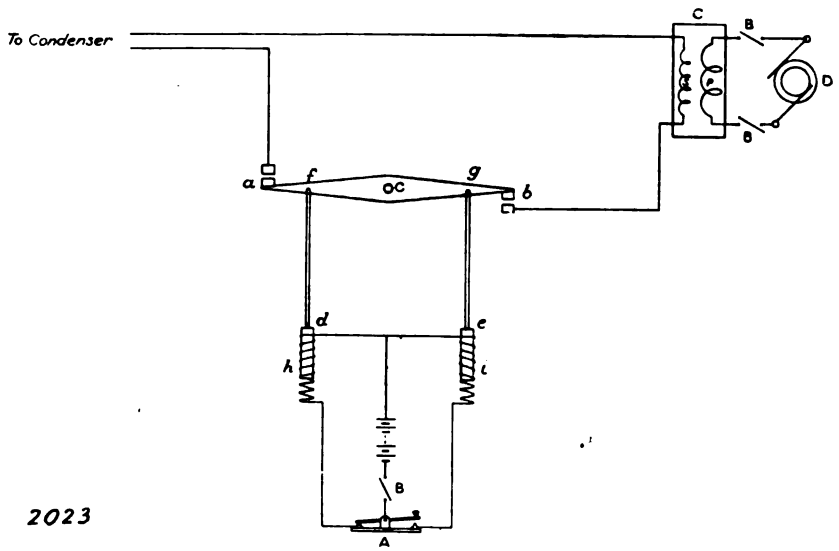
Oils.—The oil used in transformers of this class is a mineral oil having a flash-point of 360° F. and a specific gravity at 60° F. of 0·857. The viscosity at 60° F. is 171″ and at 100° F. is 75″. It is



Digitized by Google

important that the oil used be free from acid and moisture, and that no acid is produced by electrical discharge through it.

KEYING DEVICES.—For small powers where the current does not exceed 10 to 15 ampères at about 100 volts, the ordinary hand key fitted with heavy platinum contacts can be used to make and break the circuit between the alternator and transformer. For larger currents at frequencies not exceeding 80 cycles, magnetic keys are employed either of the single or double type, and connected in parallel if the current is greater than one will carry. These operate by breaking the circuit automatically when the alternating current is at or near the zero value of the half cycle following the release of




9.—MARCONI H.T. RELAY SWITCH.

the hand key, thus reducing the sparking and burning of contacts. 7 is a view of a Marconi single magnetic key, and 8 shows diagrammatically the arrangement of a double magnetic key, in which the first portion serves as a relay and is operated by direct current. The dotted connection in the second portion shows the connections for the hand key when AC only is available. The armatures A and B are drawn down by the current, against the pull of a spring, and on releasing the hand key the AC circuit is finally broken at the contact X.

On powers of 10 k.w. and upwards it is usual to employ a high-tension relay switch placed in circuit with the secondary of the transformer and having a double break and operated by direct current. A diagrammatic arrangement of a Marconi HT relay switch is shown in 9, and consists of a rocking arm, *a b*, pivoted at



Digitized by Google

*c*. Two rods attached to this arm on either side of the centre *c* are connected to iron cores, *d* and *e* within the solenoids *h* and *i*. When the battery is switched on, the back contact of the key makes the circuit though solenoid *h* and the switch is off. The front contact causes the solenoid *i* to be energised and closes the contacts *a* and *b*.

In order to avoid arcing at the HT contacts, which are of copper, an air blast at a pressure of about eight inches of water is directed on to each contact and serves to extinguish the arc.

CONVERTERS.—In small stations using 1½ k.w. or less the alternating current is frequently obtained from a rotary converter.

**10** shows a vertical spindle type much used in cargo vessels. This type is also made in larger sizes up to 25 and 50 k.w.

**10.**—VERTICAL CONVERTER WITH DISC D.C. TO A.C.

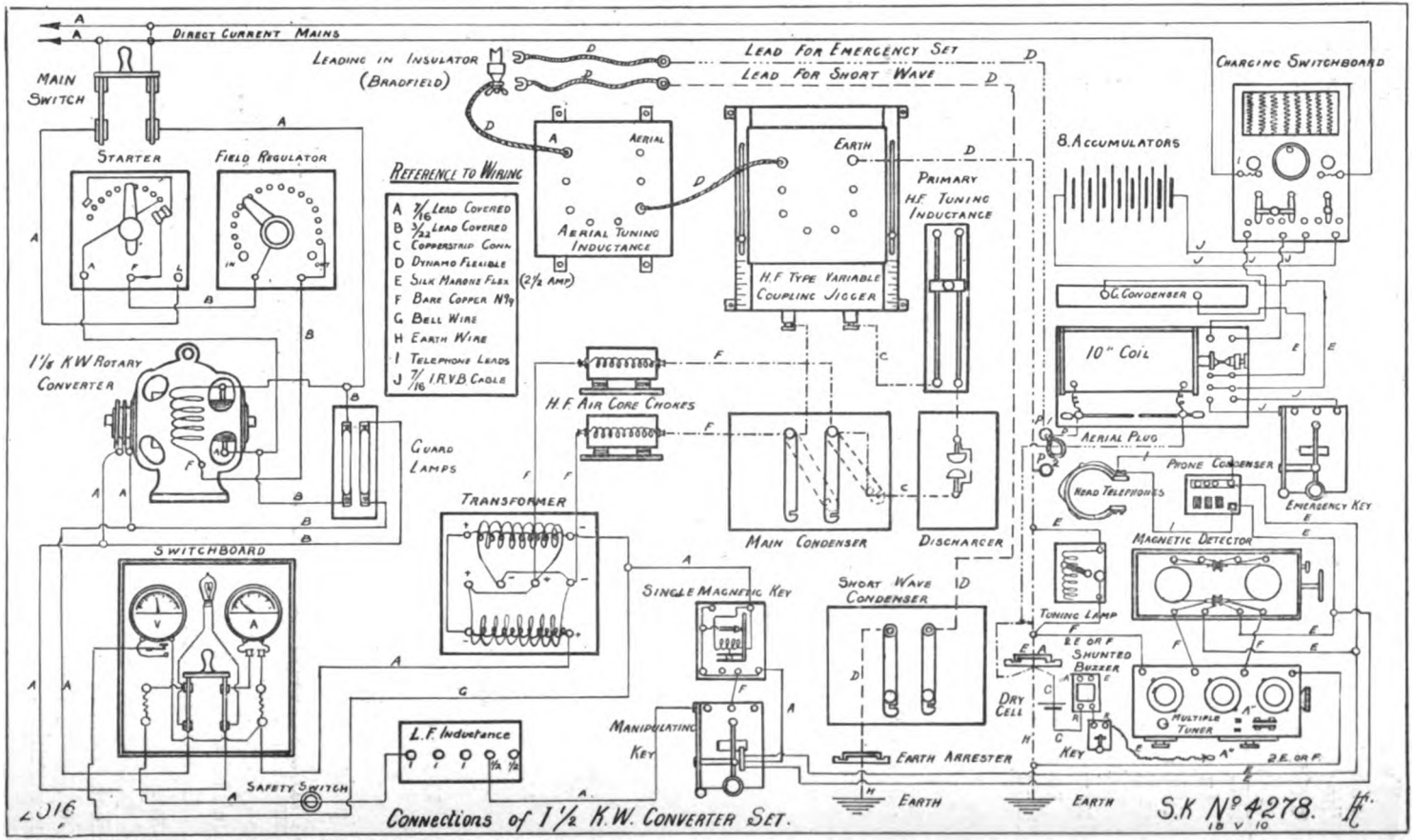
**11** shows the diagrammatic arrangement of the Marconi 1½ k.w. set.

The converter is a direct-current motor, with the addition of two slip-rings connected at two points of the armature windings 180° (electrical) apart. Four-pole machines are usually employed for the small sizes, and thus at a speed of 1500 r.p.m. gives a frequency of 50 cycles per second. The AC voltage is a fixed ratio, *i. e.* ·77 of the DC voltage supplied to the motor.

GUARD LAMPS.—The straight filament lamps shown connected across the main leads to and from the converter are for the purpose of protecting the windings of the machine against any injurious effects due to high-frequency currents induced in the leads or windings by providing an alternative path of low self-induction across the machine.

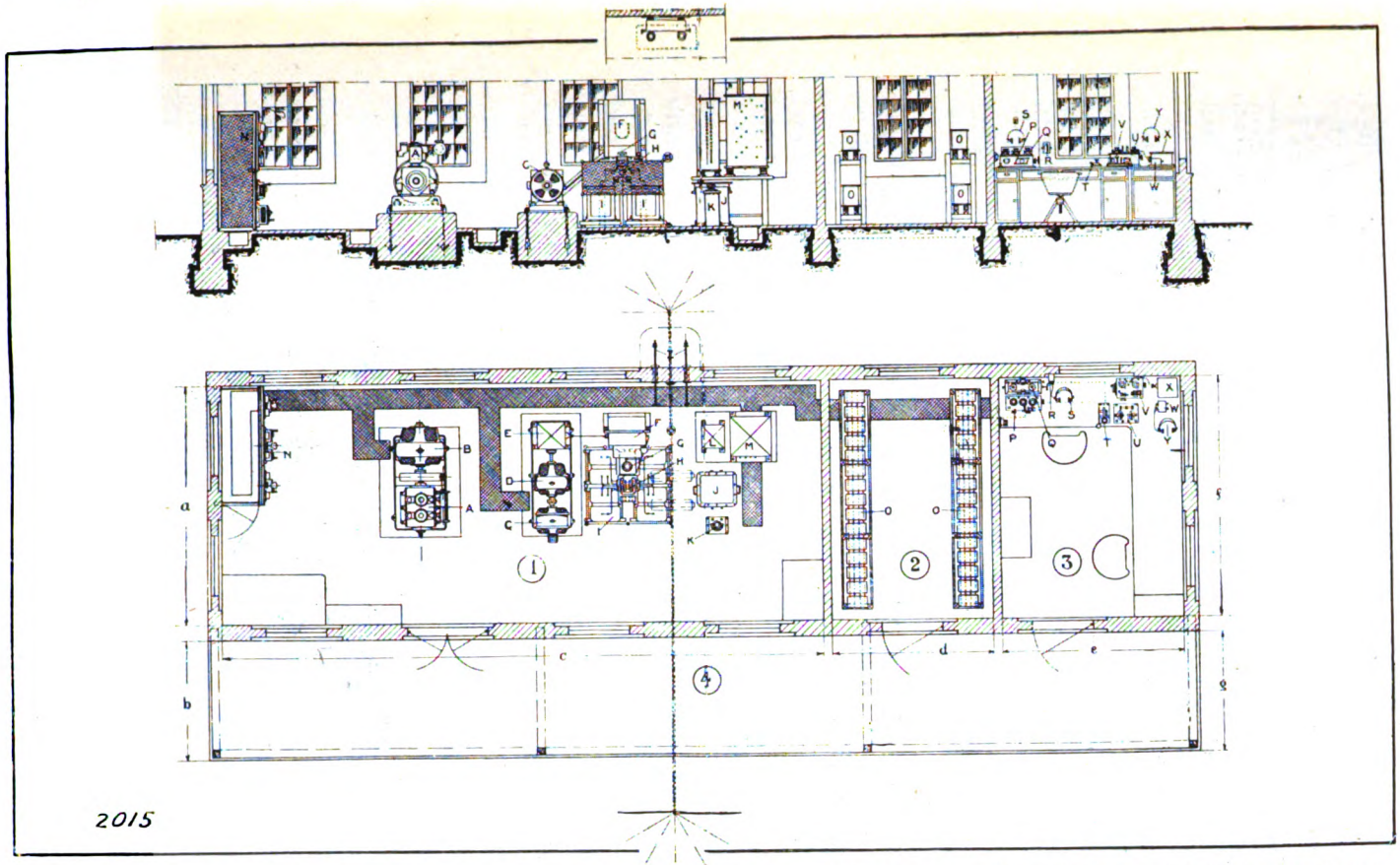


Digitized by Google




**II.**—Diagram of Marconi 1½ K.W. Set Complete for Transmitting on Two Wave Lengths and with an Induction Coil and Accumulators as an Emergency Set. The Receiving Apparatus is also shown.

Digitized by Google




**12.**—Typical Lay-out of 5 K.W. Wireless Station.—(1) Power Room. (2) Accumulator Battery Room. (3) Operating Room. (4) Verandah.

A. 2-Cylinder oil engine. B. D.C. Generator. C. Motor. D. SP alternator. E. Disc discharger in box. F. Oscillation transformer. G. High-frequency primary inductance. H. Swiss commutator. I. Transmitting condenser. J. Transformer. K. Low-frequency inductance. L. and M. Aërial tuning inductances. N. Switchboard. O. Accumulator cells. P. Multiple tuner. Q. Magnetic detector receiver. R. Telephone condenser. S. Telephones for magnetic receiver. T. Manipulating key. U. Double magnetic relay key. V. Valve receiver. W. Receiving telephone transformer (for valve receiver). X. Valve receiver battery box. Y. Telephones for valve receiver. Z. Leading-in insulators.



Digitized by Google

MOTOR GENERATORS.—For larger powers motor generators are preferable to converters, as the AC voltage is not then a fixed value, and can be regulated by varying the field excitation. The alternator is usually direct coupled to the motor, and can be designed for any ordinary frequency, and by using a higher voltage a correspondingly lower current can be used in the primary circuit, thus facilitating the operation of keying. **2** shows such a machine, the motor alternator and disc being direct coupled and on the same bed.

PRIME MOVERS.—Where a supply of electricity is not available it is necessary to provide a generating plant, and for small stations up to 25 k.w. this is usually combined with a storage battery, so that the motor generator can be operated when the generating plant is not running. But in larger plants it is more economical to avoid the secondary battery and to couple the alternator direct to the engine. Duplicate plant is then usually provided, and is kept running continuously.

The type of prime mover to employ depends upon local conditions, cost of fuel, location and power of the station, and may be either steam, oil, gas, or petrol engines.

A typical layout of a 5 k.w. station employing a 10 h.p. high-speed oil engine direct coupled to a DC generator, battery room and operating room is shown in **12**.

The writer has thought it desirable to include some of the relevant accessories necessary for controlling purposes which do not strictly come under the heading of the paper, and in conclusion desires to acknowledge his indebtedness to the Marconi Company for the loan of some of the blocks and photographs used in illustrating this article.



Digitized by Google

# AN EXPERIENCE IN HEAVY RENEWAL WORK.

By J. W. Barber.

It may be remembered that a severe snowstorm visited the north-eastern counties of England during the night of March 6th, 1909, and, amongst other damage wrought by the storm, wrecked two 120-ft. latticed iron masts which carried the Hull to West of England trunk lines across the River Ouse at Howden Dyke. Both masts broke at the "cross-trees" about 80 ft. from the ground line. The cross-trees were formed by the "spurs" to form spur stays, which stays reached from the top of the mast to a point just below the cross-trees and where the breakage occurred.

There can be little doubt that primarily the breakage was due to the rupture of small-gauge copper wires (100 lb.) by clinging snow; the only point, however, that is known with certainty is that the mast on the north side of the river was the first to break.

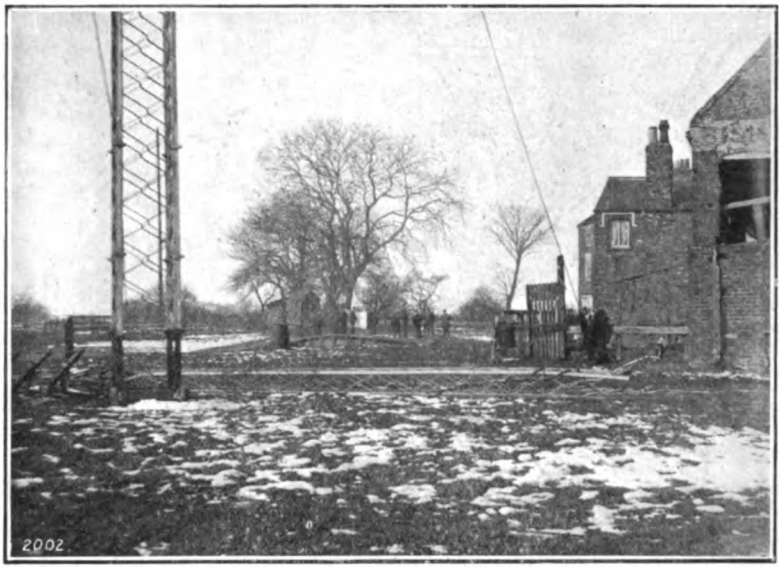
Leading up to this mast was a span only about one third the length of the cross-river span, the latter being 210 yards, with a considerable angle on the mast, and it is said that this particular mast had at some time, prior to its acquisition by the Department in 1896, been buckled and cold-straightened, which would tend to weaken it. The theory, therefore, is that the small-gauge wires first broke in the leading-up span on the north side of the river; then the weight of the cross-river span pulled the head off the mast on that side of the river, the breakage of the mast on the south side following as a natural corollary.

1 shows the stump of the broken mast on the north side of the river with the top-mast lying on the ground.

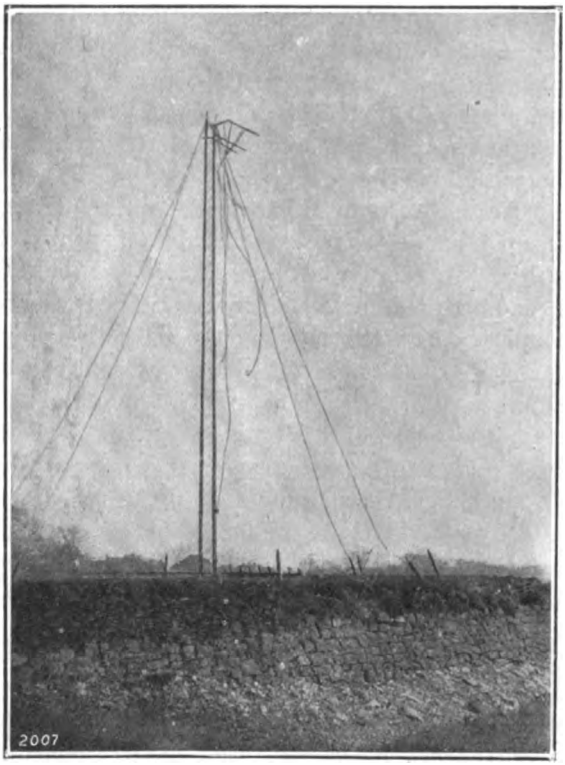
2 is a nearer view of the top mast showing the broken end, and also how it has been crumpled up just below the arms.



Digitized by Google




1.—North Side of River Ouse: 120-ft. Latticed Iron Mast at Howden Dyke broken during Snowstorm. View of Base of Structure with Broken Top-Mast lying on Ground.



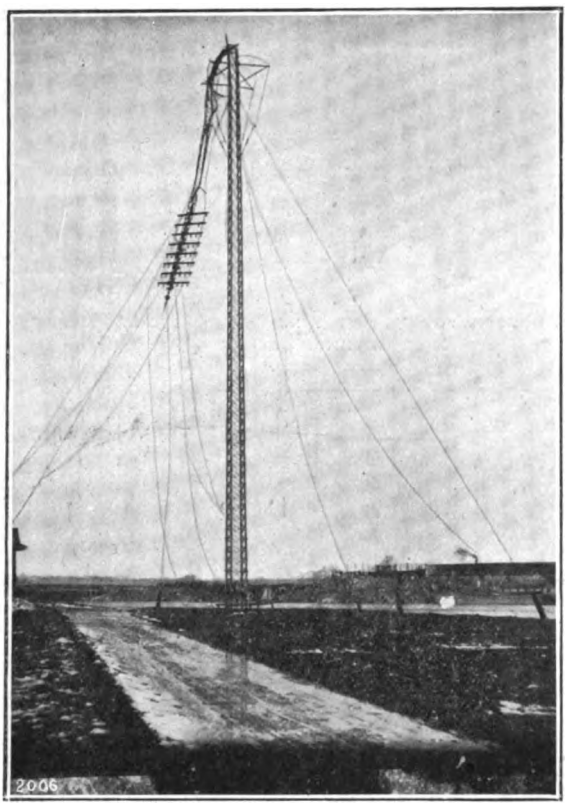

2.—Another View of 120-ft. Mast on North Side of River Ouse showing Breakage of Top-Mast.



Digitized by Google

3 shows the damaged mast on the south side of the river with the top-mast still hanging to the main portion.

Communication was restored by adding the eighteen trunk circuits (thirty-six wires) to the existing twenty-two wires on the telegraph route which crosses the river a short distance west of the trunk route—a proceeding which caused me much anxiety whenever snow



3.—Damaged 120-ft. Mast on South Side of River Ouse with Top-Mast hanging down.

threatened. However, all turned out well, and in due course new masts were erected to replace the broken ones.

The new masts were erected by a firm of contractors.

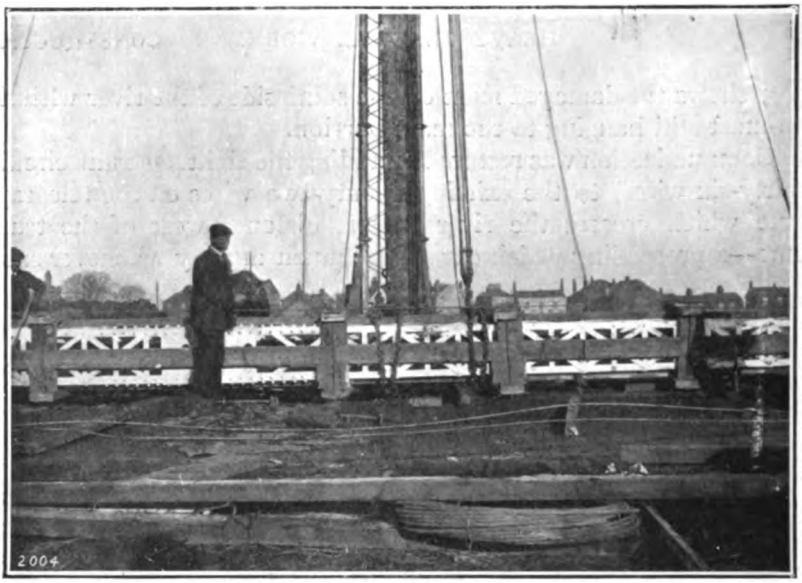
4 shows the method adopted for stiffening the mast during erection.

5 shows the new mast on the south side of the river, slung ready for lifting, and the hole to receive same, which, it might be interesting to mention, was 10 ft. deep by 5 ft. wide by 33 ft. long, tapering from 10 ft. to 0.

6 shows the new mast on the north side of the river in course of erection.



Digitized by Google



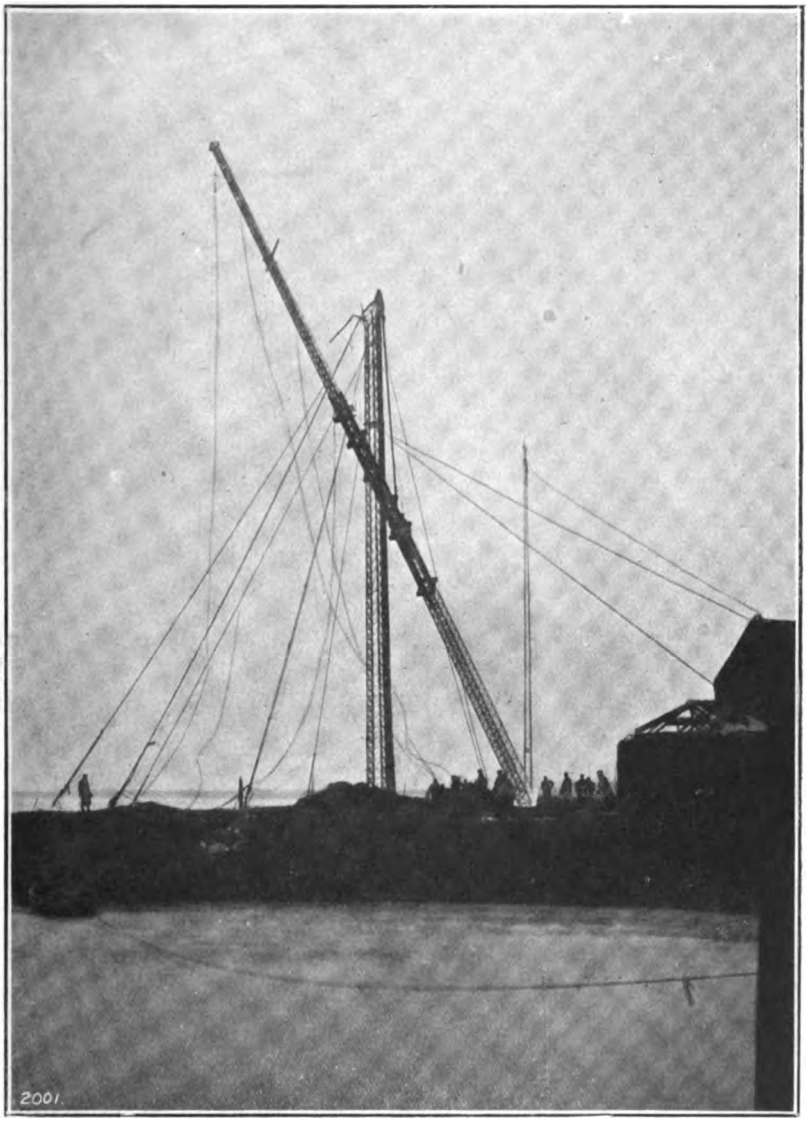

4.—Method Adopted for "Stiffening" New 130-ft. Latticed Iron Masts during Erection.

5.—New 130-ft. Mast on South Side of River Ouse slung ready for Lifting. The Broken Mast, supplemented by a Wooden Pole lashed to it, is used as a Derrick.



Digitized by Google

7 shows the mast on the north side of the river completed and in position.



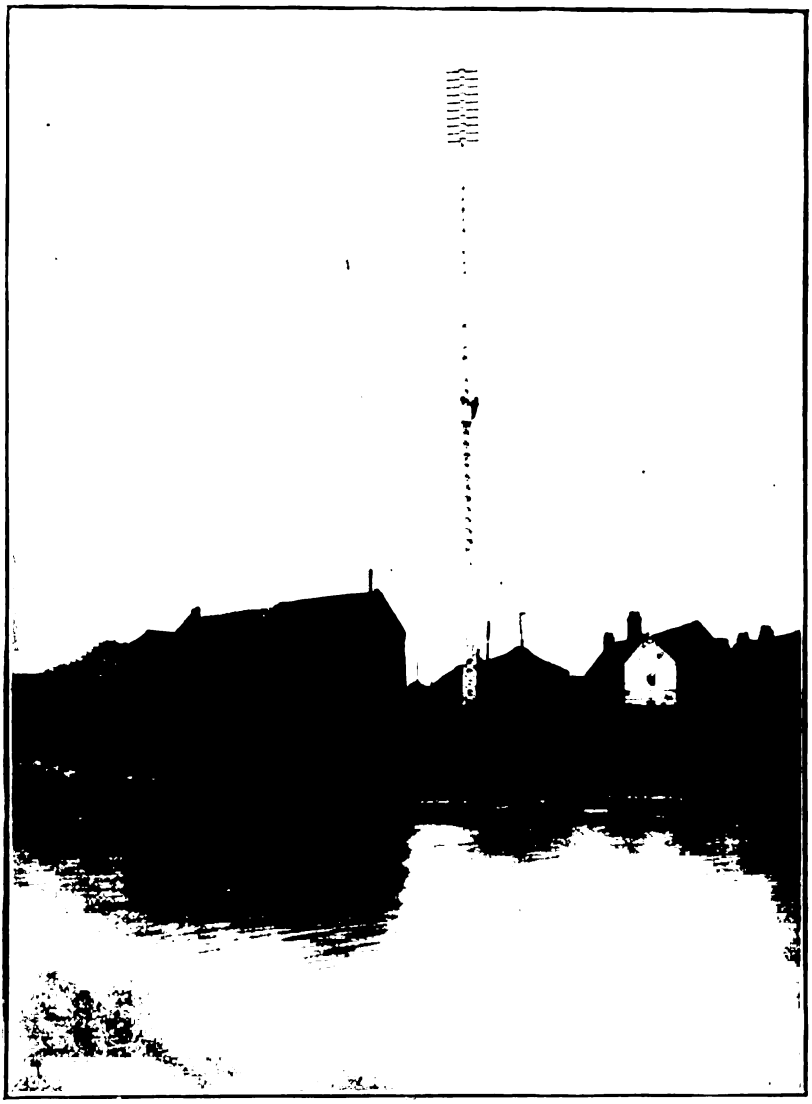

6.—New 130-ft. Mast on North Side of River Ouse in Course of Erection. Approximate Weight 5½ Tons.

It will be noticed from the photographs that the stump of the old mast, supplemented by a wooden pole lashed to it, is used as a derrick for lifting the new mast. A double and treble set of blocks



Digitized by Google

were used, the pulling-rope being led through a snatch block at the foot of the derrick and thence to a winch.



7.—New 130-ft. Mast on North Side of River Ouse in Position.

The new masts are 130 ft. in height, *i. e.* 10 ft. longer than the old masts, and the total weight of each mast is approximately 5½ tons.

Another point of difference between the old and the new masts is in the arrangement of the trellising, which may be noticed from 5. In the new masts it will be seen that the cross-pieces offer the full



Digitized by Google

width surface, whereas in the old form only the thickness of the metal is exposed. Greater strength is claimed for the later method, but it will undoubtedly be subjected to greater wind pressure, and the narrow step which the new arrangement gives is very uncomfortable for the lineman whilst climbing the mast.

The renewal was made the opportunity for placing the leading-up poles in line with the masts, and to so space them that the spans on each side are approximately equal to the cross-river span.

The masts have been fitted with twelve stays—three for each of the four sides—fitted at heights of 120 ft., 105 ft., and 55 ft. respectively from the ground line, with an average spread of 40 ft.; 150-lb. bronze wire has been substituted for the mixed gauge copper wires, and has been run from leading-up pole to leading-up pole, at which points it is terminated, and it is hoped that these precautions will prevent any repetition of the disaster.

---

## ALTERNATING CURRENT CALCULATIONS.

By F. ADDEY, B.Sc., A.M.I.E.E.

THE calculations met with in connection with circuits carrying alternating currents are usually much more intricate than those dealing with continuous currents. In fact, the reader who is not fairly adept at the use of the calculus is tempted, when he meets with such investigations, to take the results on faith, without endeavouring to follow the arguments by which they have been deduced. The solution of a complicated alternating current problem would possibly be quite beyond his powers.

A method, however, exists by which the mathematical expressions for the flow of alternating currents in any circuit whatever, no matter how complex, are reduced to exactly the same form as those for the flow of continuous currents in the same circuit, and the required solution obtained by the application of a few simple rules. This method is described by Professor Perry in his book on the calculus (article 163 *et seq.*). It does not, however, appear to be so generally known as its great utility warrants, and the following article has therefore been written to bring the method to the notice of those readers of the POST OFFICE ELECTRICAL ENGINEERS' JOURNAL who may hitherto have been unacquainted with it.

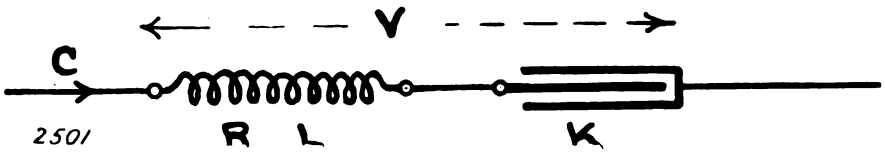
The mathematical groundwork on which the method is based has been explained more in detail than is done by Professor Perry, as the writer has found, both by his own experience and by that of his friends, that the argument as given in the book mentioned is, in parts, somewhat difficult to grasp. If, unfortunately, the reader be



Digitized by Google

unable to follow this preliminary discussion, he is strongly advised at least to learn the rules which are ultimately deduced, and to see how they are applied to the solution of problems. These rules constitute a powerful mathematical tool, and may be used even if the steps by which they are obtained be unknown.

In this method the symbols we use to denote the operations of differentiation and integration are different from those ordinarily employed in calculus work. The symbol $\frac{dy}{dx}$, or $\frac{d}{dx}.y$, which means that $y$ is differentiated once with regard to $x$, is denoted by $\theta y$. The symbol $\frac{d^2y}{dx^2}$, which means that $y$ is differentiated twice with regard to $x$, is denoted by $\theta^2 y$, and so on. We may use the symbol $\theta$ to denote the differentiation of any variable with regard to any other variable on which it may be dependent, so long as we know with what independent variable we are dealing. In the alternating current problems which we shall discuss we shall be concerned with




1.—Circuit having Resistance, Inductance, and Capacity.

the variation of current, etc., with regard to the independent variable time. Thus $\theta C$ will stand for $\frac{dC}{dt}$, $\theta^2 C$ for $\frac{d^2C}{dt^2}$, and so on.

If we apply a voltage $V$, which may vary in any manner whatever, to a circuit having resistance $R$, inductance $L$, and capacity $K$, as in 1, the relation between the charge $Q$ in the condenser at any instant and the applied voltage is given by the equation.

$$V = \frac{Q}{K} + R.\frac{dQ}{dt} + L\frac{d^2Q}{dt^2}.$$

or—

$$V = \left(\frac{1}{K} + R.\frac{d}{dt} + L\frac{d^2}{dt^2}\right) Q.$$

$\frac{dQ}{dt}$ is, of course, the current flowing through the circuit into the condenser.

Using the symbols explained above, we may re-write this equation thus:

$$V = \frac{Q}{K} + R\theta Q + L\theta^2 Q,$$

or—



Digitized by Google

$$V = \left(\frac{1}{K} + R\theta + L\theta^2\right)Q.$$

In this expression $\theta$ occurs as if it were an algebraical quantity, and it can be shown that $\theta$ can nearly always be so considered.

Thus—

$$\frac{d}{dx}(u + v) = \frac{du}{dx} + \frac{dv}{dx}.$$

Using the $\theta$ symbol, we have—

$$\theta(u + v) = \theta u + \theta v.$$

Also—

$$\frac{d}{dx} ay = a \frac{dy}{dx},$$

or—

$$\theta ay = a\theta y.$$

Finally—

$$\frac{d^2}{dx^2}\left(\frac{d^3y}{dx^3}\right) = \frac{d^5y}{dx^5},$$

or generally—

$$\frac{d^n}{dx^n}\left(\frac{d^my}{dx^m}\right) = \frac{d^{m+n}y}{dx^{m+n}}.$$

Using the $\theta$ symbol, we have—

$$\theta^n(\theta^m y) = \theta^{m+n}y.$$

Thus, so far, we have been able to deal with $\theta$ exactly as if it were an algebraical quantity. If, however, we are dealing with products or quotients of variables we cannot treat $\theta$ in this way. We know that—

$$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx},$$

or—

$$\theta(uv) = u\theta v + v\theta u.$$

If, however, we could in this case have treated $\theta$ as an algebraical quantity we should have had—

$$\theta uv = u\theta v = v\theta u.$$

In the problems we shall discuss we shall not meet with these conditions, and we may therefore take it as a rule that, for our purposes, $\theta$ may be always treated as if it were an algebraical quantity.

We have now to ascertain the meaning of the symbol $\frac{C}{\theta}$. Treating $\theta$ as an algebraical quantity, we have—

$$\frac{\theta C}{\theta} = C.$$

That is, whatever operation the symbol $\frac{1}{\theta}$ may denote, it is such that it is annulled by the operation denoted by the symbol $\theta$.



Digitized by Google

But we know that—

$$\frac{d}{dt}\int C.\,dt = C,$$

or—

$$\theta \int C.\,dt = C.$$

Thus the operation $\theta$, or differentiation with respect to $t$, annuls the operation of integrating $C$ with respect to $t$. That is—

$$\frac{\theta C}{\theta} = C = \theta \int C.\,dt.$$

Therefore $\frac{C}{\theta}$ corresponds to $\int C.\,dt$.

We have already obtained the equation—

$$V = \left(\frac{1}{K} + R\theta + L\theta^2\right) Q,$$

connecting the voltage and the charge in an electric circuit. From what has been said we may treat this equation as though its component parts were all algebraical quantities, and therefore we may write—

$$Q = \frac{V}{\frac{1}{K} + R\theta + L\theta^2}$$

That is, the charge in the condenser is given as the result of the mathematical operation—

$$\frac{1}{\frac{1}{K} + R\theta + L\theta^2}$$

performed on $V$. What this particular operation may be is not yet clear. Whatever it be, however, it must be such that it just annuls the effect of the operation—

$$\frac{1}{K} + R\theta + L\theta^2$$

performed on $V$, because—

$$\frac{\left(\frac{1}{K} + R\theta + L\theta^2\right) V}{\frac{1}{K} + R\theta + L\theta^2} = V.$$

The result of the operation—

$$\left(\frac{1}{K} + R\theta + L\theta^2\right) V$$

depends on the manner in which $V$ varies. If $V$ follow the simple harmonic law—

$$V = V_0 \sin wt,$$

we have—



Digitized by Google

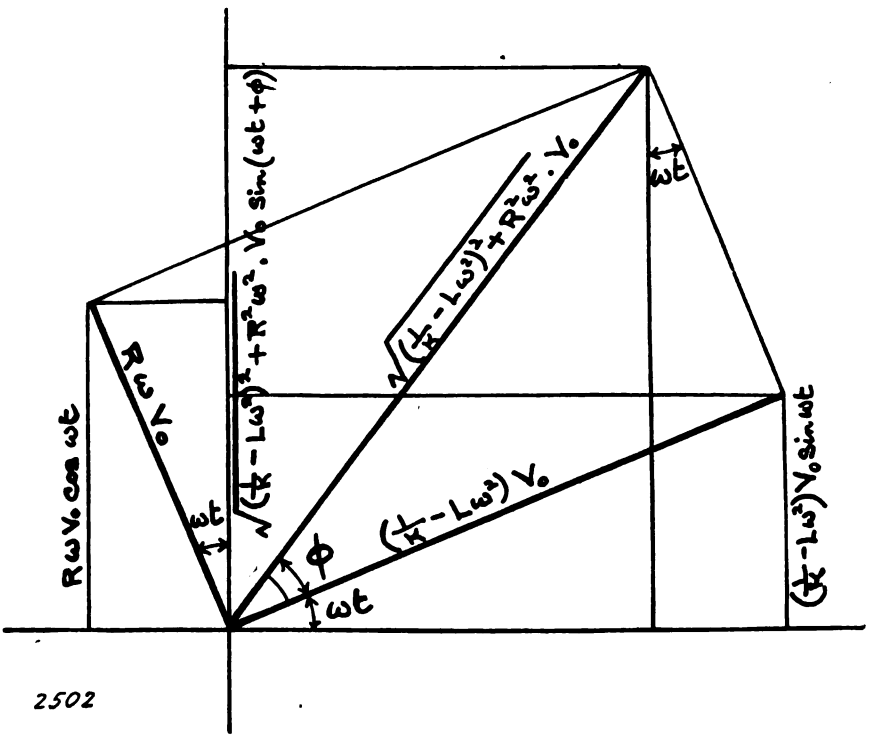
$$\frac{dV}{dt} \text{ or } \theta V = wV_0 \cos wt$$

and—

$$\frac{d^2V}{dt^2} \text{ or } \theta^2 V = -w^2 V_0 \sin wt.$$

Therefore—

$$\left(\frac{1}{K} + R\theta + L\theta^2\right) V_0 \sin wt,$$




**2.**—GRAPHICAL ILLUSTRATION OF THE EQUATION $\left(\frac{1}{K} - Lw^2\right) V_0 \sin wt + RwV_0 \cos wt$
$= \sqrt{\left(\frac{1}{K} - Lw^2\right)^2 + R^2w^2}.\ V_0 \sin (wt + \phi).$

$$= \frac{1}{K} V_0 \sin wt + RwV_0 \cos wt - Lw^2 V_0 \sin wt,$$

$$= \left(\frac{1}{K} - Lw^2\right) V_0 \sin wt + RwV_0 \cos wt.$$

By representing this equation graphically, as in **2**, we see that it is equivalent to—

$$\sqrt{\left(\frac{1}{K} - Lw^2\right)^2 + R^2w^2}.\quad V_0 \sin (wt + \phi),$$



Digitized by Google

where— $$\tan \phi = \frac{Rw}{\frac{1}{K} - Lw^2}.$$

That is the operation—

$$\left(\frac{1}{K} + R\theta + L\theta^2\right)$$

performed on $V_0 \sin wt$, multiplies the amplitude by—

$$\sqrt{\left(\frac{1}{K} - Lw^2\right)^2 + R^2w^2},$$

and advances the phase by the angle—

$$\tan^{-1} \frac{Rw}{\frac{1}{K} - Lw^2}.$$

Now, since the results of the operation—

$$\frac{V_0 \sin wt}{\frac{1}{K} + R\theta + L\theta^2}$$

are the exact opposite of that just considered, we have—

$$Q = \frac{V_0 \sin wt}{\frac{1}{K} + R\theta + L\theta^2} = \frac{V_0}{\sqrt{\left(\frac{1}{K} - Lw^2\right)^2 + R^2w^2}} \sin (wt - \phi),$$

where— $$\tan \phi = \frac{Rw}{\frac{1}{K} - Lw^2}.$$

This is therefore the value of the charge in the condenser at the time $t$.

In practice, however, we are more usually concerned with the current in the circuit. The equation—

$$V = \frac{Q}{K} + R\frac{dQ}{dt} + L\frac{d^2Q}{dt^2}$$

may be written in terms of the current thus—

$$V = RC + L\frac{dC}{dt} + \frac{fC.dt}{K}.$$

Using the $\theta$ symbol we have—

$$V = RC + L\theta C + \frac{C}{K\theta}.$$

or— $$V = \left(R + L\theta + \frac{1}{K\theta}\right)C.$$

Therefore— $$C = \frac{V}{R + L\theta + \frac{1}{K\theta}}.$$

The expression $R + L\theta + \frac{1}{K\theta}$ occurs in this equation in a similar manner to a resistance in the steady current case. It may be called the "impedance operator."

*(To be continued.)*



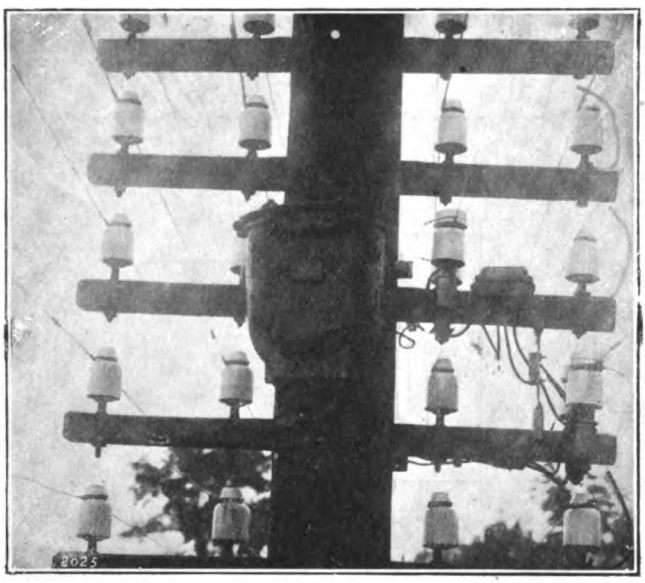
Digitized by Google

# AËRIAL LOADING.

By J. WHITEHEAD.

THE fitting of loading coils on aërial lines in this country is now an accomplished fact, coils having been fitted on two important telephone trunk circuits—viz. London—Leeds Nos. 6 and 7.

METHOD OF LOADING.—Two types of loading coils are used. Leeds 6 is loaded with coils, each having an inductance of 265 milli-henrys, and the coils are normally spaced eight miles apart, any variation from these distances depending on electrical conditions.



1.—VIEW OF AËRIAL LOADING COIL FITTED TO POLE. NOTE THE SPECIAL PROTECTIVE DEVICE, ALSO METHOD OF FITTING "LEADING-IN" INSULATORS.

Leeds 7 has a lighter type of loading applied to it, the coils used having an inductance of 160 milli-henrys spaced twelve miles apart.

In order to secure the best results from an aërial-loaded circuit a high standard of maintenance is required. The insulation should be as high as possible, as the speaking efficiency is affected to a considerable degree by the insulation resistance. Such circuits are also more subject to inductive interference than unloaded ones; the "A" and "B" lines should, therefore, be well balanced and the wires kept well clear of trees.

Loading coils, if placed on open lines without protection, are liable to damage by lightning, and this is overcome by the use of a special protector known as "Lightning protector T. 533 B."



Digitized by Google

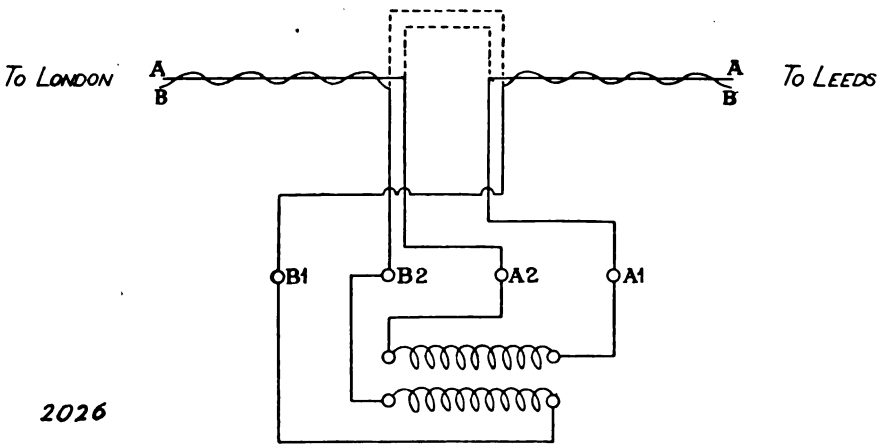
The 265 milli-henry coil is known as "Loading coil No. 512," and the 160 milli-henry coil as "Loading coil No. 517." Each case of loading coil weighs about 90 lb., and they are placed near the arm carrying the circuit to be loaded, as shown in **1.**

The following letters are stamped on the top of each loading coil-case in the order given :

B 1. B 2. A 2. A 1.

Each complete loading coil is divided into two half-coils; one half is connected to A 1 and A 2, and the other half between B 1 and and B 2. The coils are connected as shown in **2.**

The dotted lines show the short-circuiting connections which are inserted pending the coils being brought into use.




**2.**—Connection between Line Wires and Aërial Loading Coil.

It will be seen that A 1 and B 1 terminals of the coil are joined to the line-wires on the Leeds side, and A 2 and B 2 to the line-wires on the London side. It is most important that this arrangement be regularly adhered to throughout the line, otherwise the circuits will not be correctly loaded.

No heavy currents should be put through the coils, as the iron cores are liable to become detrimentally affected if 100 milli-ampères and above are passed through them. In practice any testing currents which may at any time be necessary to send through the coils should also be passed through a suitable resistance in series with the coil and the current reduced to a few milliampères.

When once loaded circuits have been brought into use, the coils should not afterwards be taken out of the circuit unless instructions are received from the Engineer-in-Chief. If, however, a definite fault is located in a coil and difficulty in working is caused

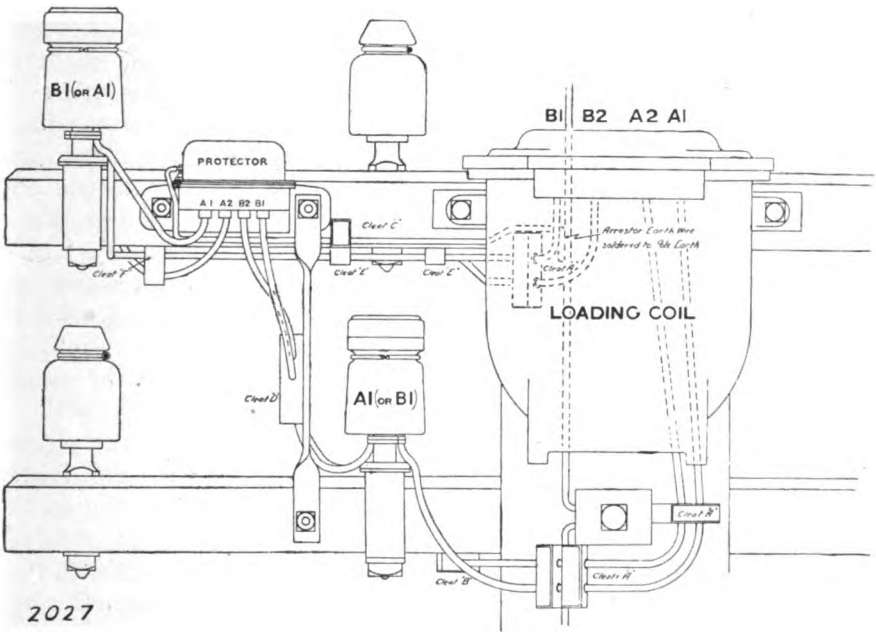


Digitized by Google

thereby, the coil is at once cut out, a similar one requisitioned, and the matter fully reported on.

In joining up the loading coils in the first instance, the wires are connected through at the insulators, as indicated by the dotted lines in 2, and these connections are simultaneously removed throughout the whole length of the circuit at a time arranged by the Engineer-in-Chief.

BRIEF SPECIFICATION OF CONSTRUCTIONAL DETAILS.—It is important that the coils be accurately spaced along the line in accordance with the electrical constants of the circuit. A slight




3.—DIAGRAM SHOWING CONNECTIONS BETWEEN AËRIAL LOADING COIL, SPECIAL PROTECTOR, AND OPEN LINE.

deviation only may be made to the extent of two poles from the theoretical point where there are distinct advantages from the points of view of construction and maintenance.

When more than one circuit on a line is loaded consecutive poles are used, the coils being so distributed as to deviate as little as possible from the exact loading point.

The coils are supplied with V.I.R. leads, about seven inches long. No joint of any kind should be made in the leads.

The coil cases are attached to the poles as shown in 3. The coil leads marked A 1 and B 1 will be connected to the "down" side of the line, and those marked A 2 and B 2 to the "up" side. No distinction is made between "A" and "B" line wires. The G.I.



Digitized by Google

strap (stock title, "Coils, loading, support for") is attached to the back of the pole by the same bolt which fixes the arm, the strap being placed between the head of the bolt and the washer.

A ¼-in. hole for the sag screw is bored in the centre of the pole below the hole for the arm bolt. Into this hole is screwed a 7½-in. × ½-in. bolt until the head projects about three inches from the pole; the screw is adjusted so that the coil case hangs vertically; the loading coils are then bolted to the G.I. support by 2-in. × ½-in. bolts, as shown in 3.

The arrester is fixed on the pole side of the higher of the two arms supporting the circuit to be loaded, and in such a manner as to enable the leads to be run direct to the insulators. The arresters are attached by means of 5-in. by ⅜-in. bolts having round washers under the nut of each bolt. An arm combiner under one or other of the bolts fixes the arrester to the arm for supporting the arrester leads. Care should be taken that the insulated lead from the coil case be neatly bent and cleated closely to the pole side. The earth wire on the pole should be tested and carefully examined, and, if necessary, renewed. The insulated leads are attached to the arms by hard-wood cleats fixed by cone head screws. The wires are terminated on terminal and leading-in insulators in standard manner. The insulators are held to the arms by double terminal irons. The terminals on both the loading coils and arresters are marked on the cases A 1, A 2, B 1 and B 2.

The insulated leads are threaded through the holes in the cleats as shown in 3, special care being taken to ensure that the coil leads and the arrester leads shall not come nearer than ¼ in. of the earth wire. The leads are kept clear of the arms, pole and lower edge of the insulator sheds, and to prevent the possibility of contact with the insulator, the leads are served with a wrapping of insulating adhesive tape.

The leads from the arrester are run as direct as possible and should not cross one another.

The fitting of the loading coals can be conveniently carried out by three men—one lineman, one wireman, and one labourer. The wires are first unbound and the terminal irons and insulators fitted to the required positions. The top arm bolt of the arm carrying the circuits to be loaded is taken out and the strap for the loading coil support fitted between the head arm bolt and the washer; the arm bolt is then tightened up to its proper position. The line-wires are terminated and the holes bored through the arms to take the special protector. The combiner is then fixed, to which is fitted a wood cleat for holding the leads from the coil clear of other wires. Having placed the necessary fittings in position, the earth wire on the pole is carefully tested and the earth lead from the protector soldered



Digitized by Google

to it at the back of the pole, directly behind the point where the loading coil is to be fitted. A ⅜-in. hole is then bored for the "sag screw," and the bolt 7½ in. by ½ in. screwed in until its head projects sufficiently to support the loading coil vertically. All is now ready to hoist the coil into position. This is done by means of stout sash-line doubled and securely tied round the shoulders of the coil case. The free ends of the line are taken over an arm above the selected position for the coil, which is readily hauled up by two men and held in position by securing the line to the pole whilst the final fixing and necessary connections are carried out.

The protector and coil leads are carefully threaded through the cleats to their respective positions, and as each insulated lead is marked and stamped on the case no mistake is likely to be made.

The time occupied in completely fitting up a loading coil to one pole approximated three men ten hours each, inclusive of travelling, haulage of tools and plant.

As will be seen from 1, the loading coil, when fitted to the pole, is neither unsightly nor conspicuous, and it may be added that the selected poles have not shown any signs of moving under their additional burden, although the coils have been in position for over six months.

---

## CIRCUIT PLANS.

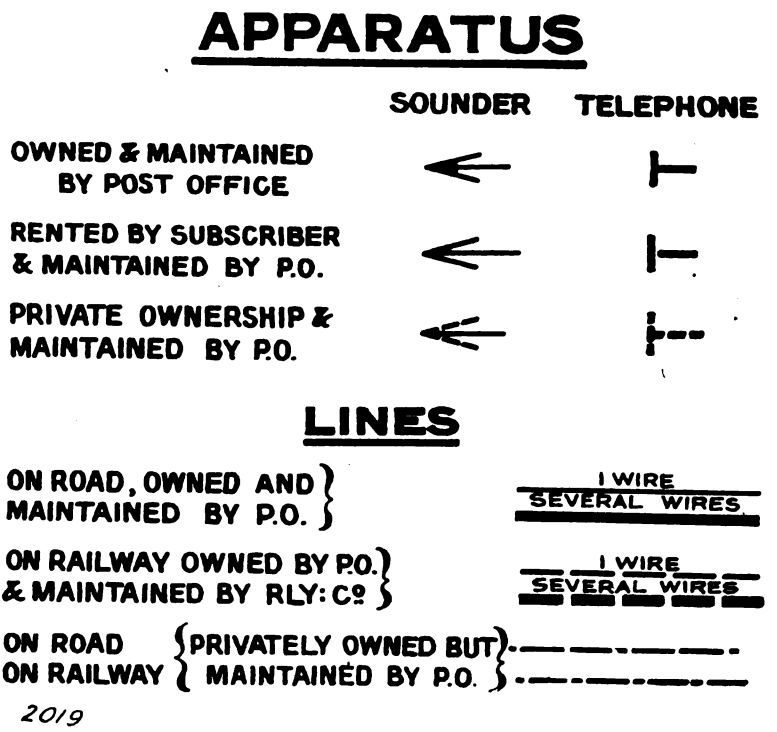
By T. Howlett.

Good circuit plans are an essential part of the organisation of the Engineering Department, and they are becoming more important every year. Ever since the transfer of the telegraphs to the State some such record of the plant maintained for the public service has been in existence. The actual plans of plant taken over from the old telegraph companies are still extant in the Engineer-in-Chief's Office, and the plans are frequently referred to in cases of claims by local bodies for compensation in respect of rates. These plans form the basis of the colour scheme which has been employed for many years to indicate the various classes of plant, and, although the method of recording has been altered in recent years, the principle still remains the same. Up till about 1900 the whole of the telegraph and telephone plant maintained in Superintending Engineers' districts was recorded on large single-sheet plans, but some of these were so cumbrous and unwieldy that they had to be mounted on rollers with a framework about the size of a comfortable four-post bedstead. These old plans were not drawn to any definite scale, and



Digitized by Google

with the advent of the telephone they were found to be quite inadequate to meet the new demands. These disadvantages were overcome by the introduction of sectional plans drawn to a scale of two inches to one mile. The colour scheme, too, involved the drawing of each plan by hand, and, as the same expenditure of labour was necessary in making duplicates as in preparing the original, it will be obvious that a considerable amount of highly skilled labour was involved. In 1903 it was decided to replace the coloured plans by a one colour system, also to revise all the symbols. This was done, with the




I.—Typical Line and Apparatus Symbols.

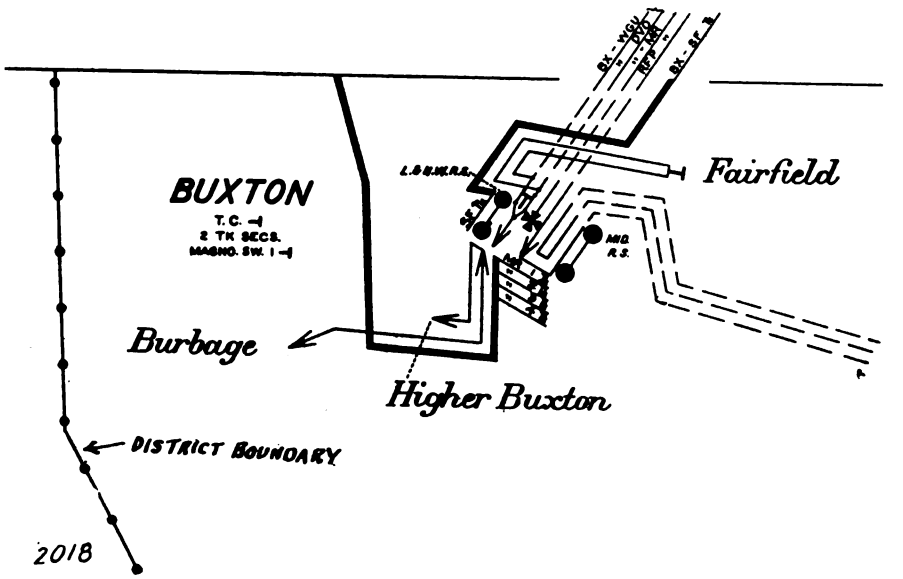
result that the preparation of the present Vandyke plans was commenced and the old coloured plans were gradually superseded. The new system possesses many advantages. The work of preparation is confined to one office and the multiplication of labour all over the country is avoided. Any number of plans can be printed, and in the event of a plan being destroyed or mutilated through wear and tear, it can easily be replaced. Owing to the large scale to which the plans are drawn the positions of offices and lines are shown approximately correct, and it is possible to estimate roughly the mileages without reference to a map.



Digitized by Google

The plans show apparatus, open lines on road, rail, and canal, underground cables, submarine cables, types of cables, and ownership, and maintenance of lines and apparatus. It is not proposed to go into detail concerning the symbols used to indicate the various classes, but one or two examples will explain the principles (1).

Generally speaking, the symbols for lines and apparatus owned and maintained by the Post Office are shown *solid*, rented lines and apparatus *open*, and privately owned lines and apparatus *broken*. The status of an office is indicated by the style of lettering employed. In Ireland the differences between the symbols are important, as,




2.—SECTION OF A CIRCUIT PLAN, ONE HALF ACTUAL SIZE, SHOWING HEAD OFFICE, SUB-OFFICES, ROAD AND RAILWAY ROUTES, TYPES OF APPARATUS, DISTRICT BOUNDARY, AND METHOD OF NAMING WIRES ON EDGE OF SHEET.

owing to the agreements in force between the railway companies and the Post Office, signalling lines and apparatus belonging to the companies are maintained by the Post Office in return for facilities on the railways, and the interests of both parties have to be safeguarded. The complicated nature of plan-drawing will be realised when it is stated that symbols have been devised to cover about 120 different kinds of lines, instruments, ownership and maintenance.

The plans generally are drawn to a scale of two inches to one mile, or twice the scale of the ordinary one-inch maps issued by the Ordnance Survey (2). If the ground to be covered is particularly congested, as in the case of large towns, the scale is increased to



Digitized by Google

twelve inches to one mile. The routes and positions of the offices are first marked on the map, and the draft is then prepared from the information contained on old plans, estimates, or any other record which may be available. The essential points of a good plan are that it shall be accurate and that the information shall be set out clearly and definitely, and it is in the careful preparation of the first draft that a good draughtsman can save trouble in the later stages. After some experience of plan-drawing and draughtsmen one cannot help remarking how surely a plan shows the individuality of the draughtsman. A good clear plan, with the lines sharply defined, shows the quick, decisive nature, although, of course, the best draughtsman, from a "drawing" point of view, may not necessarily be the best from the standpoint of the "plan" man. A good plan draughtsman, in addition to his technical skill, should have an all-round knowledge of the chief points of telegraph and telephone engineering, a genius for accuracy, and should be able to set out clearly and simply a mass of detail. After the draft has been prepared it is traced on to linen, blue prints are taken off, and a print is sent to the Superintending Engineer to be checked. There is on record the story of a local engineer (in a country which shall be nameless), who, when asked to explain the delay in checking a print, replied that the plan was "so full of omissions" that he had to draw a fresh one. Somebody suggested that he could start with a clean sheet! After correction the print is returned to the Engineer-in-Chief, the linen tracing is amended if necessary, and any authorised works are added. The latter point ensures that the plan shall be up-to-date when it is issued. The linen tracing is then sent to the Ordnance Survey Office at Southampton to be reproduced by the Vandyke process.

The Vandyke process is technically known as a "light" process. A zinc plate is coated with a composition which, after being exposed to the light, is proof against the attacks of acid. The linen tracing is placed over the sensitised zinc plate and exposed to the light. Where the black lines are on the tracing the light is unable to penetrate, so that this part of the composition on the plate is soluble in acid. The tracing is removed and acid is allowed to eat away the composition and slightly into the plate, making grooves where the black lines are on the tracing. The plate is then cleaned, so that now we have the zinc plate with the lines of the plan eaten into it. Transfer ink is rubbed over the plate and allowed to sink into the grooves. The plate is next placed on a lithographic stone and the impression transferred to the stone. Any number of copies may now be taken off the stone.

Some difficulty is experienced in making alterations to the plans as ordinary printers' ink is used, and it cannot easily be erased.



Digitized by Google

Suggestions have been made from time to time to overcome this disadvantage, but it is found that, if an ink is used which can readily be erased, it smudges or is rubbed out by friction with other plans. Alterations are at present made temporarily in pencil, and if any extensive changes take place the plan is revised and re-issued. This, however, is done in comparatively few cases, although about 6000 alterations are made each year to the 625 plans which cover the United Kingdom. The work of revision is done systematically, and when things settle down to the normal after the taking over of the National Telephone Company it is intended to arrange for the revision of the complete set of plans every five years. The linen tracings of the first edition were preserved in the hope that with slight alterations they would be available for the second edition, but the plant has increased to such a great extent that it is necessary to re-draw each plan and re-issue it as new.

The usefulness of the plans can hardly be over-estimated. They are invaluable for reference on all kinds of points, and so far as the Engineer-in-Chief's office alone is concerned they save a very considerable amount of time and correspondence. A complete set of plans of the United Kingdom is kept up to date at Head-quarters, and this enables the preliminary estimates for the year's trunk programme and for main underground proposals to be framed without reference to the Superintending Engineers. Frequently the Secretary is supplied with the approximate mileage of a proposed long-distance private wire circuit within an hour or two, and so is in a position to quote terms to the applicant almost by return of post. There are many other conveniences, far too numerous to mention, which add greatly to the quick and smooth working of an office. The information given is in some cases approximate, especially as regards mileages, but it enables a fair working figure to be given on request.

Some time and money have been spent during the last few years on a new and revised edition of the Telegraph and Telephone Route Maps, and the result certainly justifies the outlay. These maps are drawn on a scale of a quarter of an inch to one mile, and they show road and railway routes, open and underground, head offices and sub-offices, testing offices and non-testing offices, and the mileages of the principal routes. A distinction is made between telegraph routes and telephone routes, the former being shown in red and the latter in blue. The original detail of the quarter-inch ordnance map is preserved in a pale grey colour, and the information required by the Post Office is over-printed. Three colours, viz. red, blue, and black, are used, and a separate plate is required for each. When the new issue was first proposed it was intended to prepare the drafts for each plate in the Engineer-in-Chief's office, and then have



Digitized by Google

them printed by the Ordnance Survey. An experiment was made, but the result was disappointing owing to the great care and technical skill required to make the plates coincide. In the printing the red and blue lines either overlapped or slipped away from each other. An arrangement was then made with the Ordnance Survey by which the maps were drafted in full in the Engineer-in-Chief's office and sent to the Ordnance Survey for the plates to be prepared and printed. This arrangement has proved eminently satisfactory, and the maps are remarkable both for their usefulness and the good workmanship with which they have been prepared.

## DISTRIBUTING ELECTION NEWS BY TELEPHONE.

By G. F. O'DELL.

VISITORS from the British Post Office to the United States have, I think, been impressed by the complete and efficient organisation which obtains in the telephone industry in that country. A somewhat striking test of its adaptability to meet exceptional requirements was afforded last autumn by the Presidential election, at which time Mr. Turner and myself were fortunate in seeing the arrangements made in Chicago for coping with the expected traffic..

Since political conditions in America differ from those prevailing in this country, it may be well to state that the elections for President are held in all centres on the same day, on which also are held elections for members of congress and for certain State, county, and municipal offices. It will consequently be realised that interest in the elections is intense, and that practically all election traffic is concentrated in a few hours succeeding the closing of the polls.

It is probably well known that there are two competing telephone companies in operation in Chicago—the Chicago Telephone Company, connected with the Bell interest, and the Illinois Tunnel Company, which has come into operation since the last election, and which conducts an automatic system on the Strowger principle.

It will be appropriate to commence with the Chicago Telephone Company, as operating the older and more extensive system. At the last Presidential election in 1908, between 50,000 and 60,000 calls for election news were received in Chicago. But telephony has developed in four years, and the arrangements made by the Chicago Telephone Company to cope with the traffic this year were based on an expected total of 200,000 calls, though the actual total was somewhat short of this. Since 1908, too, a great change has come about in the relation of the Bell telephone companies to the Western Union



Digitized by Google

Telegraph Company. At that time the two services were competing in the endeavour to give the public speedy knowledge of results, but last November they were acting in co-operation, with the result that each was occupied solely in the work for which it was best fitted.

The news was distributed by local and toll circuits to some eighty exchanges in Chicago and neighbouring towns, and by telegraph to five distant centres in the state of Illinois, at which arrangements were made for local distribution by telephone.

News was obtained principally from the Western Union Telegraph Company on a sounder set and typed as received. Local results and miscellaneous information were received by telephone from the City Hall and City Press. As the messages were received they were taken by messengers into a small adjoining room in which a committee of half a dozen officials were engaged in compiling the news into bulletin form. Each bulletin as it was issued received a serial number and was made out in triplicate. The three copies were taken to copying tables where a large number of copies were made. These copies were distributed among about fifty readers, seated, each with a telephone, two at a table. The telephone of each was connected to two city or perhaps three outlying exchanges at which the news was written down. All of this staff were accommodated on the twelfth floor of the Telephone Company's new office building, adjoining which are Franklin and Main exchanges.

At the local exchanges arrangements were made to distribute to one or more groups, each having a maximum of 100 subscribers. The plant arrangements were designed to make use of existing spare equipment as far as possible. The telephone sets by which news was sent to other offices were connected to spare jacks of outgoing trunk multiple on the Franklin "A" board. The jacks were multipled to the corresponding ones in adjacent panels so that two or three offices could be connected to one telephone. By means of "A" cord circuits the telephones were connected to the first outgoing trunks to the various city and suburban exchanges. Two or three exchanges were connected to one telephone set, but the cord circuits used for all exchanges after the first were modified so as to supply battery to the distant exchanges but not to the telephone set, which received battery from the first cord circuit only.

At the exchanges the particular incoming trunk selected was connected to an ordinary telephone set, at which the bulletins were received and written down. For distributing the news to subscribers combination transmitting devices were used at the central offices. It was found that 20 lines could be connected to an ordinary operator's transmitter and the transmission still be good. To speak to a maximum of 100 lines, then, five transmitters were hung together, and tubes from each were led to one central mouthpiece of



Digitized by Google

tin. Each transmitter was connected to its own induction coil, condenser, and repeating coil, but the latter was so arranged as not to supply battery to the subscribers' lines, thus preventing the possibility of interruption to the bulletins.

At various points over the "B" board were suspended groups of cords, usually twenty in a group. Twenty red and twenty white cords were connected to each transmitter through a two-position switch, so that by means of the switch the reader could speak on either the red or white cords. While the red cords were being used by the reader, calls were put up by the operator in charge of the whited cords, and the operator in charge of the red cords would be waiting. When a call came in for election returns, the "A" operator would pass the number of the calling subscriber to the proper "B" operator (the call wire is switched from one to the other at the same time as the cords), and the latter inserts a white cord in the subscriber's multiple. The "A" operator then clears and can tell if the right line is taken up by the extinction of the calling subscriber's lamp. When the reader has finished reading the bulletins over the red cords, he switches to the white cords. The operator in front of the red cords is now engaged in putting up calls while the other waits. The signals to these operators are given by red and white lamps under the control of the reader. Before commencing each bulletin, the reader says—"I will now read bulletin No. —"; after reading it twice he would conclude with the words "Hang up your receivers, please; another bulletin will be read in about ten minutes."

Special arrangements were made for dealing with small outlying offices. A trunk to each of these was connected to the reader in the nearest centre, and the operator in the small office remained in and switched from one set of cords to the other at the right moment.

Though not so extensive as the manual system of the Chicago Telephone Company, the automatic system operated by the Illinois Tunnel Company has obtained a firm hold in Chicago, and arrangements were made by this company to deal with election traffic. These arrangements were not so elaborate as those of the Bell Company, partly because the actual work of collecting, editing, and reading news was left to a city newspaper, and partly because the employment of automatic apparatus eliminated the necessity for a large operating staff, as well as owing to the fact that at present there are only some 30,000 automatic as against 300,000 manual telephones in Chicago.

In preparing the arrangements the company co-operated with the 'Chicago Examiner,' at the head office of which news was collected and prepared into bulletin form. At each automatic exchange the ninth level of the first selectors was allocated for election work, and



Digitized by Google

the trunks from this level were connected through repeaters to a common terminal, at which they were bunched into a single trunk which connected the office in question to the 'Chronicle' exchange. This exchange, the nearest to the 'Examiner' office, was put into communication with the office building by another pair of wires. This pair was terminated at the newspaper office in a loud-speaking transmitter into which an attendant, was continually reading bulletins of results and other election news. A subscriber wishing to obtain election news dialled "9" on his calling device and was thus connected to a non-busy trunk from the ninth level of a first selector straight through to the 'Examiner' office and so was able to hear the results announced.

In concluding this brief description of the methods adopted in the second city of the United States to spread to its inhabitants news of the recent Presidential election, it is a pleasure to acknowledge the courtesy and consideration shown by the officials of both companies. Such treatment would have earned our gratitude at any time, but it was the more appreciated for being displayed at what must have been a time of pressure and anxiety to all those in charge of the comprehensive arrangements which were made.

# NEW IDEAS.

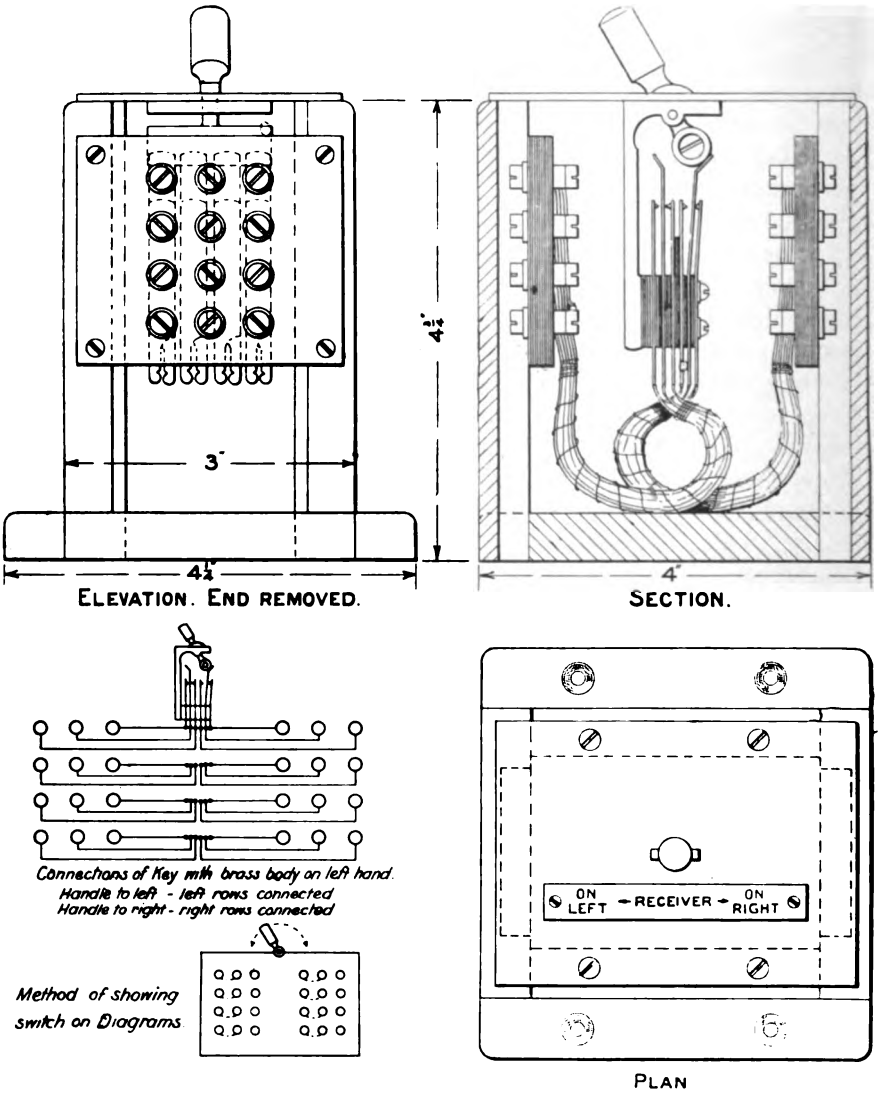
## A USEFUL SWITCH.

THE following figures show the construction of a compact and cheap form of 24-point switch that has recently been introduced as a standard stock list item with the title "Switch, Repeater Leak, 24-point." It is primarily intended for use as part of a duplex repeater for Baudot circuits, where its function will be to interchange the leak relay and leak receiver between the "up" and "down" sections of the line. It is really a small and cheap equivalent of the well-known "8-bar switch," which has been used by the Post Office for many years, and in addition to the purpose for which it was designed, it is likely to prove useful for special circuit arrangements and for making up testing and experimental circuit schemes. As will be seen from the figures, the new switch consists of a 24-way key of telephonic type (Key No. 33A) fitted in a case and wired to two ebonite tablets with four groups of three terminals each. The wiring is so arranged that the key and its top plate can, when required, be lifted sufficiently clear of the case to allow the contacts



Digitized by Google

to be examined and cleaned without disconnecting any of the wires. The connections are so arranged that each terminal in the central




vertical rows is connected to the terminal on the right-hand side of it when the handle of the switch is turned to the side marked "right," and *vice versâ*.



Digitized by Google

# POST OFFICE ENGINEERING DEPARTMENT: NINTH ANNUAL DINNER.

THE dinner was held on January 29th, 1913, at the Connaught Rooms, Kingsway, W.C., the chair being taken by Mr. William Slingo, Engineer-in-Chief to the Post Office. A large and representative gathering of the staff assembled.

The guests of the evening included the Right Hon. Herbert Samuel, M.P., Postmaster-General; Mr. W. Duddell, F.R.S., President of the Institute of Electrical Engineers; Sir John Gavey, C.B.; Sir Robert Hunter, K.C.B.; Mr. A. M. J. Ogilvie, C.B.; Mr. H. S. Carey, C.B.; Mr. R. Bruce, C.B.; Mr. G. Morgan, I.S.O.; Mr. J. Newlands, C.I.E.; Mr. F. Gill, Mr. W. W. Cook, Mr. J. F. C. Snell, Mr. H. H. Dalrymple Hay, Mr. Alexander Siemens, Mr. F. A. Cortez-Leigh, Mr. J. E. Kingsbury, Major Kennedy, R.E.; Mr. H. Hirst, Mr. A. H. Preece, Mr. M. S. Conner, Mr. H. R. Kempe, Mr. A. B. Walkley, Mr. H. M. Pease, Mr. A. Brooker, Mr. J. T. Crowe, Mr. A. G. Ferard, Mr. W. T. Leech, Mr. D. Stewart.

After the banquet, which was served in the Grand Hall, the usual loyal toasts preceded the Postmaster-General's speech.

In proposing the toast of "The Engineering Department," Mr HERBERT SAMUEL said:

Mr. Chairman and Gentlemen,—It gives me great pleasure to propose the toast of "The Engineering Department." I think there never has been an occasion when the Department is more deserving of toasting than it is now that we have passed through the year 1912. It has been not only an interesting year, but a most arduous year for many branches of the Post Office, and for the Engineering Branch perhaps most of all. You have been concerned with vast changes—the inventory of the National Telephone Company's plant and the transfer of that great undertaking to the State, the amalgamation of the two systems and of the two staffs; the arbitration, which, I suppose, was the greatest arbitration of the kind that has ever taken place in this country, and the readjustment of our engineering districts. All these things have made for the Engineering Department a year of interest indeed, but also of arduous work, and even possibly one might say of turmoil. The Engineering Department has been living through a time almost of upheaval, and I am sure you will be glad to look forward to a few years of calm and peaceful development without further changes. One other event has happened during the year which, perhaps, some of you might wish to see continued and repeated in future years, and that is the introduction of higher scales of pay for certain of the classes. That is the kind of change of which one cannot have too much. But my experience has been that whenever I have been successful in persuading the Treasury to make additions to the remuneration of any branches of my staff—and the occasions have been rare, not for lack of goodwill on my part, but through obduracy on theirs—but whenever I



Digitized by Google

have persuaded the Treasury to make advances of any kind my letter-bag is full, not of expressions of gratitude and thankfulness, but of indignant, and, indeed, violent protests. Those who have received are replete and quiescent (laughter); they are content, and say nothing. Those who have not received have a new grievance, greater than any that ever have oppressed them before, for not only have they not got anything, but their neighbours have, which is worse than all. However, I hope that now these matters have settled down. Various complaints have received careful consideration. Some changes, as you know, have been made, and I hope that now we shall go on more or less happily. The efficiency of this great new telephone business that we have taken over depends, of course, to a large degree, upon the way in which it is worked by the Engineering Staff of the Post Office. The public, if anything goes wrong, blames either the unfortunate girl operator at the exchange or else the Postmaster-General. Really, however, more often than not it is the engineer who should properly be criticised (laughter), and, therefore, I trust that out of your sympathy for the operator on the one hand, and for the Postmaster-General on the other, you will do your best to see that the public gets a really efficient and satisfactory service, and is kept in as good a temper as may be.

The future development of the telephone service, as you are all well aware, is greatly bound up with the introduction, to a continuously increasing degree, as it promises to be, of automatic systems. The experiments that have been made have been very successful, and the Department is taking steps to extend the use of automatic appliances. We have had some very interesting reports from your late Engineer-in-Chief, Major O'Meara, who, although he no longer holds that office, is still assisting the Department as special commissioner, and is investigating telephone systems on the continent. He has been able to furnish the Department with some valuable technical reports. I heard to-day that Major O'Meara has qualified as a barrister, and, therefore, is turning his energies to new directions. (Cheers.)

One other development will be of great interest to the Department, and that is the provision of a tube railway for the exclusive use of the Post Office in London. I am myself greatly interested in that scheme, and I am glad to say I have got Treasury authority for that. A Bill will have to be introduced into Parliament. The scheme is well advanced, and the Post Office will before long be able to make the proud boast of having a tube of its own for the carriage of its mails and parcels from one end of London to the other. So we go on, and so the Department, with its traditional enterprise and energy, proceeds from one world that it has conquered to the next. But its efficiency depends not merely on the men who make up the body of its staff, but also on the men who are at the head of its branches, and it is a great pleasure to me to toast—and I am toasting him for the first time—your new Engineer-in-Chief, Mr. Slingo. (Cheers.) And you are all, I am sure, very glad to welcome him in that position and to meet him to-night in the chair at your banquet.

The Engineering Department is a very remarkable one. For many long years, while it has had various changes of chief—we are pleased to see one of them, Sir John Gavey, here to-night, fortunately, if one may judge from



Digitized by Google

appearances, with his health very completely restored — the Engineering Department has had several changes of chief during the last twenty years, and marvellous to relate not one of them has been a Scotchman. (Laughter.) I remember hearing a story of a Scotchman who came from some town in the north to London on some business or other, and when he got back to his native place he was asked by a friend, "What did you think of the English?" He said in answer, "I had nothing to do with the English; my business was with the heads of the Departments." Well, here, at all events, in the Engineering Department we have a man who is not merely an Englishman, but a cockney, born and bred in London. (Cheers.) And, as you know, he has risen in the Engineering Department from the lowest ranks up to the top. He is a home-made Engineer-in-Chief, and he has those sterling qualities which one usually associates with the home-made article.

Well, gentlemen, I will ask you to drink to the health of the Engineering Department, coupled with the name of the Engineer-in-Chief, Mr. Slingo. (Cheers.)

Mr. W. SLINGO, replying to the toast of "The Engineering Department," said:

Mr. Samuel and Gentlemen,—It is indeed a great honour to occupy the position which I hold at the present moment of having to respond to a toast so ably and so kindly put. It is an honour to the Engineering Department to have this toast proposed by Mr. Samuel to-night. The Engineering Department is one which lives on its results, lives by its works, and I think that we are fully appreciative of any kind word which is said in our behalf. Mr. Samuel very kindly referred to the possibility of a few years of calm and peaceful repose which are to follow the events of the past twelve months. I wish I could see them. (Laughter.) It would be a grand thing for all of us if we could see, not years, but even hours of calm and peaceful repose. The importance of the work and the honour and credit of the Department are undoubtedly on the minds of every man at headquarters, and of every man in the districts. I feel sure of that.

The Engineering Department is increasing. It is increasing rapidly. Our expenditure this year is twice as much as it was last year. As a rule the Chancellor of the Exchequer would say that it is not much to boast about. Neither would it be if we were not able to show that we had done more than twice as much work for the double expenditure, and I think we might almost claim that our work goes up in a very high ratio with our expenditure. The staff increased during the year by the acquisition of the National Telephone Company's staff from 9000 to 16,000 men. That is a big staff. It is something to know that 16,000 men can work together with one object. It is decidedly encouraging to know that 16,000 men are at the present moment working on this one object with a minimum of internal friction. Internal friction is the one thing which will bring almost any piece of machinery to ruin, and internal friction would very speedily destroy the whole of the Engineering Department. The parts would fly asunder. What we so amply desire is a lubricant, a lubricant which will run freely, and that is mutual trust. (Hear, hear.) Now, the staff has had a reorganisation and a largely extended benefit has resulted. All those who have benefited have been congratulated,



Digitized by Google

and may again be congratulated, but the point I would like to make very clear to-night is that I want every member of the Engineering Staff to be filled with the idea that there is always something in front to be gained. I don't want a contented staff. A contented staff is a staff without ambition, and a staff without ambition can never progress. What I desire most of all things is to have every man looking forward to something which will be personally and mutually beneficial. The abolition of examinations, except at the one and most important stage, will have a most important bearing upon the future of many men, but I hope no one will be simple enough to imagine that because there is to be no examination there will be no selection. There are some people—and I am one of the number—who are inclined to think that an examination by another or extraneous body is a device for transferring the responsibility of selection. (Hear, hear.) Now, I am prepared to hold, and keep, that responsibility to the utmost, and I am prepared to make the selection as keen as ever it was before. All I desire to impress upon you at the present moment is this, that Efficiency is spelt with as big an E to-day as ever it was, and, if possible, a little bigger. (Cheers.)

The inventory has almost been forgotten—it is so long ago. Do you know that it is actually twelve months since we finished taking our inventory? But I wonder if anyone realises how much work there was in those inventory operations. Just this afternoon I had it calculated out how long it would take one man to do the checking work already done by the Post Office upon the inventory as prepared by Mr. Gill, and I find that it would take that one man 225 years. (Laughter.) I am afraid even the long age which might by the greatest stretch of the imagination be ascribed to the most obdurate type of plant would have lapsed and the plant fallen out of existence long before that inventory would have been completed. The valuation, which succeeded the inventory, and to some extent proceeded concurrently with it, was another big work. It did not take so many men; it did not occupy so long a time; but the concentration was greater. The labour was more strenuous, the whole work was more taxing, and, although there were only 133 man-years involved in the valuation of the Company's plant—(laughter)—those man-years are not to be reckoned at the rate of six, seven, eight or even ten hours a day. Those are man-years of twelve, thirteen, fourteen hours a day, and no rest on Sundays. Only those who went through that mill will ever know the extent of the grinding, and I think the time will come when credit will have to be given to some of those officers who so zealously and so whole-heartedly threw themselves into this work. You may remember that the last time we met here I was sitting a little lower down the table. It was some two years ago. I prophesied then that we were in for a fight—a severe fight—with a foe worthy of our best metal. I think I spoke truly. We had a hard fight. We had a worthy fight. Sir Alfred Cripps said he had given no quarter—and he had not—and he had asked for none—and he did not get it. And yet, notwithstanding the vigour of that tussle, I think—in fact, I am sure—that everyone recognised that it was an honourable fight, a noble fight, a fight that those who took part in it would be proud of for all time. And, when that fight was over, there was one thing that struck me more than anything else we had been



Digitized by Google

more than seventy-four days in that court, and at the end of that time there was a great scene of hand-shaking all round. (Applause.) If this is not evidence of the good feeling which animated us all in that historic struggle, I do not think any Court of Law, or any other institution, can devise a better means of demonstrating, what I know was a fact, that there was the utmost good feeling.

I think I have said enough by way of reply for the Department. I have tried to show Mr. Samuel and the other gentlemen who were so kind as to toast us in this way how we appreciate their kindness, and how we value an evening like this. There is one last point I may refer to. The telephone service has now passed into the hands of the State, and every citizen is a shareholder—one man, one share; one share, one growl. (Laughter.) The growls may vary, but their number should be limited. I suppose the growl which, fortunately, the engineers have little to do with, is that of the people who get charged for calls which they say they never make; when they want to know why the operator puts Mrs. Jones's cook through to Mrs. James's butler when she wanted him to meet her, and, if the operator neglected her duty by putting Mrs. Jones's cook through to Mrs. James's butler, why the meter metered the call. (Laughter.) Gentlemen, I thank you very heartily for the kind response you have given to the toast of the "Engineering Department." (Cheers.)

Mr. W. NOBLE, on rising to propose the toast of "The Visitors," said:

Mr. Slingo and other colleagues of the Engineering Department,—I rise on your behalf to offer a hearty welcome to our guests. It has been said that we engineers have a good conceit of ourselves. I would rather put it that we are proud of our profession, but I can say this on behalf of the whole of the Engineering Branch, that if our annual gathering were to partake of the nature of a family gathering it would pale to insignificance when compared with this excellent function to-night. We have with us not only the *élite* of the Post Office service, but we have the *élite* of the allied engineering professions outside the service (cheers), and to these gentlemen we give a very hearty welcome indeed.

Of our guests this evening I should like first to refer to those gentlemen whom we may call the "officially dead," namely, our veterans. We are pleased indeed to see with us to-night Sir John Gavey, Mr. Kempe, Mr. Carr, Mr. Catley, Mr. Johnson, and several others. Sir John Gavey, we all know, has always had a tremendous fund of energy, and now that a certain matter in which he has been most interested has been settled, we hope he will conserve his remaining energy so that he may be present at many more such gatherings as this. He will always have a very hearty welcome. I feel it rather strange to refer to our friend Mr. Kempe as a veteran, as it is only a few days since he left us. Perhaps I can best express our feelings with regard to Mr. Kempe by saying that recently, when he delivered a very interesting address at our Institution, one of the gentlemen, who was asked to make a few remarks, made the shortest speech on record: "Mr. Chairman and gentlemen,—Can you wonder that we all love Kempe." (Applause.)

Next I should like briefly to refer to our "officially live" guests, and first



Digitized by Google

and foremost, of course, I would like to mention the guest of the evening, Mr. Samuel. (Loud cheers.) Needless to say we very much appreciate his kindness in coming here to-night, snatching a few hours from his very busy life at St. Stephen's. I never like to pay compliments to a high official, more especially if that official is present, but I really thought before it was my turn to speak that Mr. Samuel would have left for the House. I will only say that it is the universal opinion of all officers of the Post Office hat we never have had a more able Postmaster-General, nor one who has taken such a deep interest, and has obtained such a grasp of the work of the great department over which he presides. No Postmaster-General has ever been more popular, and it is a popularity of a lasting nature, due to his conscientious and earnest endeavour to do justice to all the officers and men in the Post Office.

Never before, I think, gentlemen, have we had such an array of officers from the various branches of the service. To-night we have from the Secretary's office Mr. Ogilvie, Mr. Carey, Mr. Walkley, Mr. Ferard, and Mr. Leech ; from the Accountant-General's department, Sir Charles King, Mr. Maclean, and Mr. Bunce.

We are pleased to welcome Mr. Morgan, the Controller of Stores, and Mr. Allen. We have two other Controllers here, both doughty Scotchmen—Mr. Bruce and Mr. Newlands.

We have, as I have said, not only the *élite* of the service, but we have the *élite* of the outside electrical engineering profession. First and foremost, I should like to refer to the presence here to-night of Mr. Gill and Mr. Cook. Recently these gentlemen joined us in labour in another place. To-night we are pleased to welcome them to refreshment in this place. I hope it will not be the last occasion upon which they will honour us with their presence. I have no doubt that Sir Robert Hunter will agree with Mr. Slingo in saying that in Mr. Gill and Mr. Cook they met foemen worthy of their steel. In mentioning one of these names it just occurs to me that I omitted a few moments ago a very important official, namely, the ever-green, yet not so very green, Sir Robert Hunter. (Applause.) I do not think Sir Robert Hunter has ever been absent from our annual dinner, and when he ceases his work in connection with the Department I hope he will still grace our table, and that he will still help us to get permission to erect our very symmetrical and beautifully coloured poles in our lovely English lanes and on our village greens. (Laughter.)

From the outside, we have the profession of Consulting Engineers represented by Mr. Duddell (cheers), Mr. Snell, Mr. Dalrymple Hay, and Mr. Preece (cheers). Preece is a household name to telegraph engineers, and I am sure you will agree with me in asking Mr. A. H. Preece to convey to his father our regret that his health does not permit his joining us, but that we hope he will enjoy many years to look back on his past triumphs, and to watch the progress of the Department which he so long presided over with such great credit and honour.

We also have representatives from the manufacturing firms in the persons of Mr. Hirst, Mr. Kingsbury, and Mr. Siemens ; from the great cable companies in the persons of Mr. Carson of the Anglo-American Co., and Mr.



Digitized by Google

Crowe of the Eastern Telegraph Co.; and from the railway companies we have Mr. Cortez-Leigh, Mr. Rock, Major Kennedy, and Mr. Sayers. All these gentlemen we are pleased to welcome on this occasion.

I am afraid, gentlemen, that in the short time at my disposal I may have made some omissions, but one and all we welcome very heartily to our annual gathering. With this toast I have to couple the names of Mr. Ogilvie and Mr. Duddell. I think Mr. Ogilvie has been present at all our annnal gatherings and we have no more welcome guest. Mr. Ogilvie is the head of what we think is the most important branch of the Secretary's office, namely, the telephone and telegraph branch, and with such a chief it is hardly necessary for me to say that the relations between that branch and the Engineer-in-Chief's Office are of the most cordial character. Besides being an ideal chief, Mr. Ogilvie is an excellent type of an English gentleman, and he has the advantage of being an English gentleman born in Scotland. (Laughter.) Mr. Duddell needs no introduction to such an assembly as this. (Applause.) Besides, Mr. Duddell is no stranger at our table. Mr. Duddell is the youngest, I believe, and certainly one of the most able gentlemen who has ever occupied the chair of the Institution of Electrical Engineers. He has had a brilliant past, and those who know him best believe that he has a still more brilliant future. We are very pleased indeed to see his name published as a member of the expert committee on the wireless question, and with such a committee, presided over by such an able judge, we can look forward with equanimity to the judgment of that committee.

Gentlemen, I ask you to give a hearty welcome to our visitors.

Mr. A. M. J. OGILVIE, in replying to the toast of "The Visitors," said:

Mr. Chairman and Gentlemen,—I feel that after the interesting speech which the Postmaster-General has given you, I may well follow the example of the last gentleman who has addressed you, and who always makes the very shortest speeches—the gentleman who took the photograph. (Laughter.) I am also glad to think that I am justified in this course by the fact that you are all waiting to hear Mr. Duddell, whom we are all pleased to see here this evening. Mr. Duddell is not only President of the Institution, which so worthily represents the profession to which you all belong, but he is a gentleman of whose achievements in the fields of electrical research and invention we are all proud. (Cheers.) I shall, therefore, gentlemen, confine myself merely to as few words as possible in returning thanks for those of your guests who are connected with the different departments of the Post Office. All, more or less, as Mr. Noble said, are dependent in their work upon the co-operation of the Engineering Department, but we can do nothing unless the Engineering Department have laid the foundations. It is, therefore, a great pleasure to come to a gathering such as this and express our cordial feelings and thanks to those gentlemen whom in a scattered and large service like the Post Office we have so few opportunities of meeting, and I am afraid that the ordinary circumstances of official intercourse do not give opportunities of expressing our real feelings. It is also a pleasure to us, I think, gentlemen, that we should be able to express our admiration of the achievements of the Engineering Department. Reference has been made to one special piece of work which has taken place in the last year, and, as having been present



Digitized by Google

during the greater part of the Arbitration proceedings, I can to the utmost confirm what the Postmaster-General has said to-night of the splendid work done for the Post Office. I refer not only to the great and arduous duties which fell on Mr. Slingo and his chief assistants, but I am glad also to refer to the work which was done by the staffs under Mr. De Lattre and Mr. Martin. As you all know, gentlemen, in the course of the arbitration an agreement was arrived at with regard to the fundamental costs. That agreement had the effect of shortening the proceedings and making an early settlement possible. I am sure that the success and achievement of that result to a great extent depended upon the sound judgment and skill and laborious work done by those gentlemen to whom I have referred—done, I should say, out of sight and probably unknown to many of those now present.

I must also express our admiration for the work which was done on the other side by gentlemen, many of whom are here to-night, and whom we are proud to welcome to the Post Office service. (Applause.) As Mr. Slingo has said, it was a great and glorious fight, but it had this great advantage over other fights, that whereas after most battles comes the mournful duty of burying the dead, there was no such unpleasant duty to perform in this case. On the contrary, we are able to join forces with those on the other side and continue the struggles of the future in co-operation.

Gentlemen, I need not say more. I assure you that all your guests are grateful for the opportunity of meeting you to-night, and desire to express their cordial appreciation of the work of the Engineering Department.

We are convinced that in the future we may look forward to the same assistance and support from the staff under Mr. Slingo as we received in the past in the days of our friend Sir John Gavey, and other Engineers-in-Chief. (Cheers.)

Mr. DUDDELL, also replying for the visitors, said:

Mr. Chairman and Gentlemen,—It gives me the greatest pleasure to rise on my own behalf and on behalf of the guests to thank you for the pleasant entertainment you have given us to-night, and also to thank Mr. Noble for the very kind way in which he has proposed this toast. Now the toast is the toast of "The Visitors," and somehow I have difficulty in believing I am a visitor here. I have attended a good many of your dinners. Looking around I see a number of faces I know, and I have the feeling that I ought to be one of you. (Hear, hear.) In fact, I have very pleasant remembrances of a tiny hotel on the Irish coast where one of the "officially dead," and indeed some of those who are here present, sat round a little table and discussed wireless matters, when wireless telegraphy had not got across the Atlantic. In those days I had the pleasure of meeting a great many of the Engineering Staff in the Test-Room of the G.P.O. West, and I don't know why, but I have always from that time felt that I was rather more one of you than an outsider. The remembrance has always been a pleasant one, and it gives me pleasure to meet those whom I had known on that little expedition.

The Engineering Section of the Post Office is one of the most important engineering undertakings in this country, and I may say in the world. More capital is involved, more people are engaged in it. We know that the Post



Digitized by Google

Office now has a large generating station on the other side of the river. We also heard to-night that you are going to run an electrical railway underneath London and have a real tube of your own. Another engineering work of the Post Office is going to become one of the big engineering works in the United Kingdom. Not only in regard to capital involved, but you are going to deal with big apparatus comparable with the big electrical undertakings of the country. And this makes me all the more pleased to be able to come as a visitor and friend among you to-night. As you have used my name coupled with the Institution of Electrical Engineers, of which I have the honour to be the President, I should like to remind you that the Institution of Electrical Engineers was originally the Society of Telegraph Engineers, which started its life when telegraphy was in its infancy. And I am quite certain that the right thing will be for as many Post Office engineers as possible to interest themselves in the work of my Institution so that we may together advance electrical industries and the work of the Engineering Department of the Post Office. (Cheers.) One of the speakers spoke of having a few years of repose. I fear the minds and the brains of an engineer are of a different type. Engineers are always wanting to do something to go ahead. I do not believe it is possible for many engineers to have any repose. They have always been wanting to improve and aspire and to do finer things. I thank you most cordially again for the hearty way in which you have drunk the toast of the guests. (Cheers.)

Mr. A. W. MARTIN, in proposing the toast of "The Chairman," said:

Gentlemen and Brother Officers,—I would ask you to consider our Chairman not as our chief particularly, but as a personality. Most of you know that Mr. Slingo started a system of education which has resulted in producing for the Engineering Department of the Post Office a very large number of men, who, I believe, are still hard at work in the forefront of telegraph and telephone engineering. Technical education is essential for real progress. Mr. Slingo has always been a pioneer of technical education, and the fact that he has been selected for the post of Engineer-in-Chief since the date of the last dinner shows that his work in this and other connections has been recognised. I should point out that he is not only a telephone engineer, but also a power engineer. It is perhaps known to most of you that he and one of our honoured guests to-night, Mr. Brooker, wrote a book on power and electrical engineering twenty years ago, which is still a standard text-book on the subject of electrical engineering, and which should lead us all to a greater knowledge of the power work which is involved in that scheme of which we have learned a little to-night in connection with a postal tube, which is to run from the Post Office to Mount Pleasant, and maybe elsewhere. Mr. Slingo has performed a great deal of work in connection with the valuation of the National Telephone Company's plant. Only one or two of us who know and have been intimately acquainted with him, and have been pleased to assist him to the best of our ability, have any knowledge of the amount of work which has been involved, and the value of the guidance which he was always ready to give. We could never go to Mr. Slingo with a difficulty without his having some suggestion to make as to its solution.



Digitized by Google

I have the greatest pleasure in asking all of you to honour this toast of our Chairman, the Engineer-in-Chief of the Post Office.

Mr. W. SLINGO, in reply, said :

Mr. Martin and Gentlemen,—I appreciate to the full all that Mr. Martin has said and the way in which you were good enough to receive what he said and to drink the toast. It is very kind of you, and words will not permit me to say all that I would otherwise like to say, but I do assure you that it is my earnest hope that through the year, or years to come, as may be vouchsafed to us, you and I will be able to work together for our mutual benefit, for the advantage of this great department, and for the progress of engineering. I think there is nothing I can say in amplification of this small summary, and I would like you to take it with you as something to remember, and to inspire you in the strenuous times that are before us. Gentlemen, I thank you.

A slight innovation was introduced in the arrangement of the evening by calling on all those gentlemen who had to propose and respond to the toasts to do so before the commencement of the usual musical programme. This enabled the artistes to do justice to themselves, and a word of praise is due to Miss Bessie Jones for the most excellent rendering of her songs, Mr. Gerald Adams, who accompanied Miss Jones in "A Night in Venice," and Mr. Fred. Curtis and Mr. Wilson James, who furnished the humorous portion of the programme, while Mr. Richard Tonking rendered valuable service at the piano.

The evening terminated with the singing of "Auld Lang Syne" shortly after 11 o'clock.

The committee who had charge of the arrangements may be congratulated upon having achieved the success which their hard work deserved, and, as on previous occasions, the lion's share of praise should be accorded to the energetic and experienced Secretary, Mr. H. North.

## HEADQUARTERS NOTES.

### TELEPHONE ARBITRATION: GOVERNMENT CELEBRATION.

THE Postmaster-General on Friday, January 24th, 1913, entertained at dinner at the House of Commons a number of those associated with the Post Office in the recent arbitration proceedings in connection with the purchase of the National Telephone Company's business by the State. The Prime Minister was prevented from attending by indisposition. The following were present: The Chancellor of the Exchequer, Captain Norton, the Attorney-General, the Solicitor-General, Sir George Murray, Sir Henry Babington Smith, Sir Matthew Nathan, Sir Alexander King (Secretary to the Post Office), Sir Robert Hunter (Solicitor to the Post Office), Mr. Crabb (Second Secretary to the Post Office),



Digitized by Google

Sir John Gavey (Consulting Engineer to the Post Office), Mr. Ogilvie (Third Secretary to the Post Office), Mr. Horne (Assistant Secretary, Telephones), Mr. W. Slingo (Engineer-in-Chief), Mr. Alexander Siemens, Sir Hugh Bell, Sir George Gibb, Sir Frederick Donaldson, Sir William Peat, Sir John Barran (Parliamentary Private Secretary), Mr. J. F. C. Snell, Mr. Arthur Preece, Mr. Leake, Mr. Young, Mr. Haward, Mr. Robert Hammond, Mr. Harper (Chief Valuer, Inland Revenue), Mr. Buckmaster, K.C., Mr. Branson, Mr. Schwabe (Junior Counsel for the Post Office in the case), Mr. Elliott Dodds, Mr. Hurcomb and Mr. Sambrook (Private Secretaries), and Mr. A. W. Martin, Mr. A. L. De Lattre, Mr. Edwin Williams, Mr. W. E. Twells, Mr. H. Brown, Mr. McIntyre, Mr. Bunce, and Mr. Sparkes, all of the Post Office.

Mr. Sydney Buxton was unable to attend, as he had been commanded to Windsor.

The Postmaster-General expressed the thanks of the Government to all those concerned on its behalf in the arbitration proceedings.

## Major W. A. J. O'Meara, C.M.G., R.E., Engineering Special Commissioner.

Major O'Meara, late Engineer-in-Chief, has been leading a very active life since he took up his present official duties. In addition to investigating the telegraph and telephone services of Holland, Denmark, Germany, Bavaria, Wurtemberg, Italy and Belgium, and giving several lectures in this country, notably those on "The Importance of Correct Time" before the British Science Guild (of which he has been a Vice-President, and the Executive Committee of which he joined last year), "Telegraphs and Telephones" before the Yorkshire Section of the Institution of Electrical Engineers, and "Economics of Engineering" and "Legal Knowledge Essential to an Engineer" before Faraday House students, he has qualified as a barrister. It is interesting to note that Major O'Meara was called to the Bar on January 27th last—the eve of his jubilee—and we congratulate him on this latest increase in his numerous distinctions.

## An Official Adieu.

A notable gathering assembled at G.P.O. West on February 16th, 1913, to bid official adieu to Mr. H. R. Kempe.

What a splendid testimony to his sterling qualities the crowded meeting was!

Among those present were Sir A. F. King, K.C.B. (Secretary to the Post Office), Mr. G. Morgan, I.S.O. (Controller of Stores), Sir J. Gavey, C.B., Mr. W. Slingo (Engineer-in-Chief), Messrs.



Digitized by Google

A. J. Stubbs and W. Noble (Assistant Engineers-in-Chief), together with all the heads of Sections at Headquarters. In addition, several veterans of the Engineering Service attended to honour their old friend and colleague. Visits to Headquarters by Messrs. M. F. Roberts, A. W. Heaviside, I.S.O., H. Hartnell, W. Brown, E. Catley and T. Reid are infrequent nowadays, but none the less welcome.

Mr. Slingo opened the proceedings, and in well-chosen words expressed the feelings of regret, shared by all at Headquarters, in parting with their friend, Mr. Kempe. He asked Mr. Kempe, on behalf of himself and other friends, to accept a silver tea and coffee service, together with a gold bracelet watch for Miss Kempe.

Sir John Gavey bore eloquent testimony to Mr. Kempe's mathematical prowess, also to his inventive genius, but best of all to the close friendship he (Sir John) had enjoyed with Mr. Kempe for a period extending over forty years.

In reply, Mr. Kempe was modest and unassuming as ever. He referred to his labours in the Post Office as being likened to silken cords which, instead of weighing him down with the cares of office, had tended to bind him more closely to his many friends in the Service. In conclusion, Mr. Kempe stated that he would never forget his friends and colleagues at the Post Office. For our part, Mr. Kempe may rest assured that his example and influence for good will never be forgotten by his *confrères* at the G.P.O.

## Obituary.

The sympathy of a very wide circle of friends is extended to Mr. Henry Hartnell and his family in the sad bereavement which has recently befallen them in the death of Mrs. Hartnell, who passed away on February 23rd, 1913, after a brief illness.

Although Mr. Hartnell has retired from active service, he maintains a lively interest in the Engineering Department of the Post Office, whilst as a member of the Editorial Board of this Journal from its foundation, his deep scientific knowledge and erudition have always been available for the benefit of our readers.

## Organisation of Engineer-in-Chief's Office.

The arrangement of work in the Headquarters Office has been modified in several important particulars as from February 1st, 1913.

The Head Office work has been divided into three main branches, internal, external, and general, each of which has been subdivided into sections, as shown below:

*Internal branch: Designs.* — Design and specification of telegraph and telephone apparatus. Supplies of apparatus. Fire alarm systems. Drawing Office. Engineer-in-Chief's stock accounts.



Digitized by Google

*Equipment.*—Specifications for manual exchange installations, including power plant (the Power Section to be consulted when necessary) supplied under contract, and supervision of erection. Standard circuit diagrams. Building plans, accommodation and furniture.

*Telegraph.*—Maintenance of telegraph apparatus. Maintenance testing arrangements. Estimates and authority for internal telegraph work. Arrangement and lay-out of telegraph instrument rooms. Trials of new devices for telegraph circuits. Miscellaneous internal equipment, such as emergency call systems, electrically controlled clocks, time registers, etc.

*Telephone.*—Maintenance of telephone apparatus. Estimates and authority for internal telephone work carried out by Superintending Engineers. Traffic data in connection with new Exchange proposals. Telephone circuits devised to meet special (non-standard) conditions. Telephone transmission questions. Provision and erection of automatic telephone systems.

*Wireless.*—Investigation, provision and maintenance of wireless systems, including the power plant for coast stations, but the Power Section will be consulted when necessary.

*External branch: Construction.*—Standardisation of methods and instructions for external construction work of all kinds. Supplies of line stores. Protection against fire and extraneous power currents. Internal wiring of buildings and of telephone exchanges up to main test frame. Specification and new designs for stores and tools used for construction. Wayleave questions and agreements (as a temporary measure).

*Local lines.*—Proposals and authority for, and progress of, local telephone lines and local telephone distribution. Maintenance of local telephone lines. Local line plans.

*Main lines.*—Proposals and authority for, and progress of, telephone trunk lines and telegraph main and local lines. Fault returns and maintenance of all lines other than local telephone lines. Submarine cables (including cable ships). Main line plans. Supply of maps and charts.

*General: Power and lighting.*—Power plant, including lifts, conveyors, stamping machines, etc., not directly associated with the telegraph and telephone systems. Power plant for Imperial wireless stations. Electric light work. Heating and ventilation. Pneumatic tube systems.

*Research.*—Special investigation work, in association with other sections concerned. Important quantitative tests. Charge of experimenting room and workshop.

*Test.*—Examination of all engineering supplies obtained under stores orders. Specifications for wire, cables, and sundry materials.



Digitized by Google

*Accounts and contracts.*—Accounting work. Annual estimates—vote and capital. Issue of invitations to tender and placing of contracts. Statistical records and returns. Records of expenditure. Annual mileage and apparatus records.

*Editorial and typing.*—Editing and issue of printed instructions. Control of typewriting section. Control of registry. Supply of stationery. Engineer-in-Chief's library.

*Staff.*—Organisation and staff work.

---

## LONDON DISTRICT NOTES.

NEW EXCHANGES.—The new buildings for Victoria and Museum exchanges are rapidly approaching completion.

A site has been purchased for a new city exchange, which will be known as Charterhouse, and will be completed within two years.

A new building for an exchange at Greenwich is also nearly ready. The work of straightening out the exchange area distribution is proceeding, and in addition to the 16,000 lines transferred from one exchange to another during 1912, some 5000 lines were transferred in January of this year, and a further 5000 have been arranged for July next. Probably another 20,000 transfers will be necessary to secure a proper economy of distribution.

NEW TELEPHONE LINES.—During the thirteen weeks ended March 1st, 1913, 4021 exchange lines, 3286 internal extensions, and 324 external extensions were completed. In the same period 2593 exchange lines, 1637 internal extensions, and 193 external extensions were recovered, making a nett increase of 1428 direct exchange lines, 1649 internal extensions, and 131 external extensions. In the same period 5350 removals and small works were carried out for subscribers.

EXCHANGE EXTENSIONS.—Extensions of the equipment are proceeding at the following exchanges: Dalston, East, Regent, Hop, Kensington, New Cross North, Battersea and City, providing a total of 16,000 additional exchange sub-connections. The Regent exchange, which was not commenced till after the transfer of the Company's plant and was opened on October 16th, 1912, now boasts over 4000 stations, and Park exchange, opened in November, has some 1700 stations working.

TRUNK EXCHANGE.—Thirty additional positions recently installed were opened for use at the London Trunk Exchange on March 10th.

EXTERNAL CONSTUCTION.—The provision by the London City Council of a new subway at the entrance to the Mansion House station of the District Railway to facilitate foot-passenger traffic at the point where Queen Victoria St. crosses Cannon St. is causing considerable trouble and expense.



Digitized by Google

A main route of fifty-four ducts exists at this point, and there are also P.O. cables in the existing L.C.C. cable subway. Both these are being lowered below the level of the new subway. To provide for the cables in the ducts two new manholes are being built, one on each side of the passenger subway and a cable subway is being built beneath the passenger subway which connects the two manholes. Pneumatic tubes and distribution cables are also involved.

Much work is being done in relieving congested cable distribution heads in the City area. In some cases small sections of M.D.F. are being installed in adjoining basement premises, and in other cases the straight-through circuits are being diverted to short lengths of cable so as to leave the C.D.H. space free for circuits which distribute in the vicinity.

LONDON ENGINEERING DISTRICT: FIRST ANNUAL GATHERING.—A gathering of the London Engineering District staff will take place at the King's Hall, Holborn Restaurant, on Saturday, April 26th, 1913. The entertainment has been planned to suit all tastes, and will commence with a dinner at six p.m., after which a concert and a dance (proceeding concurrently in separate chambers) will be the order of the evening. Ample accommodation exists, and there will be room in the lounges and vestibules for old friends to foregather.

In view of the fact that this function will be open to all members of the Engineering Staff and friends, and that it is the first annual gathering of the combined staffs—pre-transfer and ex-N.T. Co.—of the newly constituted London Engineering District, a large attendance is anticipated. Intending visitors should secure their tickets early so as to avoid disappointment. The price of these is 4*s.* 6*d.* each, or 8*s.* double (for lady and gentleman), and they may be obtained from the Hon. Secretary, Mr. A. Wright, Denman Street, London Bridge.

## LOCAL CENTRE NOTES.

### LONDON CENTRE.

ON December 3rd, 1912, a large party of members visited the Royal Arsenal, Woolwich. The visit was a very instructive one, but unfortunately the time at the disposal of the visitors was all too short, and it was not possible therefore to inspect all the shops in this huge Government Department. A second party made a visit on December 10th. The thanks of the Institution are due



Digitized by Google

to Colonel Adair, the Chief Superintendent of Ordnance Factories, for the facilities placed at the disposal of the parties.

By the courtesy of Mr. Pollard, provisional arrangements have been made for visits to the "Monarch" in April and June next.

On January 13th Mr. J. H. Pattman read a paper on the "Electrophone." The event was interesting, inasmuch as Mr. Pattman is the first officer of the late National Telephone Company to read a paper before the Centre. It is hoped his example will be followed by other of the late Company's officers in the future.

On February 10th Mr. S. A. Pollock read a paper on "Loading Coils," detailing the results of Post Office experiments and research work with various types of coils. This meeting was honoured by the presence of Mr. Mordey, a Past-President of the Institution of Electrical Engineers, who took part in the discussion.

Messrs. Hart and Hilyer read a joint paper on "Trunk Telephone Communication" on March 10th, and with the reading of this paper the present Session is practically at an end.

Upon the eve of going out of office the Committee desire to place upon record their appreciation of the services rendered to the Institution by their Chairman, Mr. A. L. DeLattre, their sometime Vice-Chairman, Mr. J. R. M. Elliott, Superintending Engineer, Newcastle, and his successor, Mr. R. Waring.

The Committee regret to record the death of Mr. J. W. Kirby, which occured in the fall of last year. Mr. Kirby was the first Honorary Secretary of the Centre, an office he held for two years, afterwards acting as Local Librarian of the late Metropolitan North District. Although aware for some time that he was doomed by a fatal disease he struggled bravely on, refusing to give up his work, and he practically died in harness. In him the Department has lost a faithful servant, and his colleagues a true comrade.

---

## NORTH-EASTERN CENTRE.

On January 21st, 1913, Mr. W. Aitken, of the British Automatic Telephone Manufacturing Company, Liverpool, delivered a lecture entitled "The Automatic Telephone System," before a company of over 110, in the Lecture Room of the Leeds University, kindly lent for the special occasion. Mr. T. B. Johnson occupied the chair.

Mr. Aitken opened his lecture by relating the brief histories of several exchanges at which the automatic telephone system had been installed in the place of "manual," and showed the remarkable growth in the number of subscribers which followed immediately after the completion of the automatic system. He then



Digitized by Google

dealt fully with the technical explanation of the system, showing by means of lantern-slides the skeleton diagrams, and explaining the several functions of the different pieces of apparatus which form part of the system.

A model automatic telephone set was fitted up in the room, and a practical demonstration materially assisted those present to more readily understand the working principles.

Everyone present felt at the conclusion that they had been under the magic spell of the enthusiast and expert.

Mr. A. Longden moved the vote of thanks.

Our February meeting as announced looked prosaic, and one is almost inclined to say commonplace: Mr. P. A. Corney, "Some Notes on Correspondence." It was, however, the most enjoyable meeting ever held in connection with the local branch of the Institution.

It is dangerous ground, this official correspondence, but the clever manner in which Mr. Corney skated around the danger spots, glided beautifully past those rugged places where many would have fallen, swept majestically along the slippery way without fear, nay, lightheartedly, and ultimately landed home safe, was a treat which those present thoroughly enjoyed.

How interesting it was for those facing the members to watch the sly flickering smiles which chased each other across the faces of those listening to Mr. Corney, and how the flicker burst into a flame, a good Yorkshire laugh with sides shaking taking possession of the countenances!

It was good to believe that every clever thrust was intended for the fellow over yonder, and to see how each arrow, smilingly thrown at the meeting, could not find a resting place in any bosom of our good members, although time and time again one could see that the pricking of the point had been felt, the nerve muscles became taut for a moment; but no, out came the point—'twas for the other chap over yonder.

Everybody was delighted with the high literary character of the paper, and the sly humour which crept into it.

The vote of thanks which Mr. Johnson proposed at the conclusion must have well repaid the lecturer.

## NORTH-WESTERN CENTRE.

A meeting of the Centre was held in the Lecture Hall of the Preston Scientific Society on December 9th, 1912, when Mr. W. Moon contributed a paper entitled "Stresses in Telegraph Construction."



Digitized by Google

The subject was exhaustively dealt with, and was illustrated by apparatus specially designed by the author. A useful discussion followed.

A visit was paid to the Pneumatic Engineering Works of Messrs. Peter Pilkington, Limited, Bamber Bridge, on January 20th.

The firm very kindly afforded the members every facility for seeing the various processes in the manufacture of air compressors, pneumatic power hammers, pneumatic forge hammers, etc., and the visit proved highly interesting and instructive.

A successful social evening was held in the Geisha Ball-room, Crown Hotel, Preston, on Monday, January, 6th, 1913, which was attended by upwards of 100 members of the District Staff and their friends.

The first portion of the proceedings was devoted to progressive whist, after which there was an interval, when refreshments were served.

Upon resuming, the Superintending Engineer (T. E. P. Stretche, Esq.), who was received with considerable applause, expressed the pleasure it gave him to see such a representative gathering, and referred to the good feeling which existed amongst the various sections of the staff. Mrs. Stretche then presented the whist prizes to the winners.

Musical items were contributed by Mrs. D. E. Davis, Messrs. Barratt, Dransfield, and Southgate, the first named also very ably officiating in the capacity of accompanist.

Dancing was then indulged in until the close, Messrs. Pickett and Airey sharing the onerous duties of M.C. for both the whist and the dancing.

Thanks are due to the Committee who took the arrangements in hand, and also to the donors of the prizes—Messrs. Stretche, Sullivan, R. A. Jones, J. W. Graham, and the Clerical Staff.

---

## SOUTH-WESTERN CENTRE.

The Session was opened on December 3rd with a Presidential address by Mr. Tremain. The subject chosen was "Heavy Construction Work," with special reference to the reconstruction of trunk routes which was about to be undertaken in the South-Western District.

On January 21st Mr. A. E. Chapman read a paper on the "Bournemouth C.B. Exchange," and also gave an interesting description, with useful data, of the various works involved in the transfer of 2300 lines from the old magneto exchange.

This centre was favoured, on February 11th, by a visit from Mr.



Digitized by Google

B. O. Anson, of the Engineer-in-Chief's office, who repeated his lecture on "Automatic Switching Systems." In addition to the valuable lecture interest was stimulated by the practical demonstration. All who could possibly attend were present to see and handle the apparatus.

The presence of Mr. Noble (Assistant Engineer-in-Chief), who was in Bristol on that day, was much appreciated by the members.

Further meetings have been arranged for March and April.

## SOUTH LANCS. CENTRE.

The second meeting of the Session was held at Manchester on December 9th, 1912. There was a good attendance of members and visitors to hear Mr. H. R. Kempe deliver his lecture on "Reminiscences of the Telegraph." The lecture proved full of historic interest and lively anecdote and was highly appreciated. A vote of thanks to the lecturer was passed unanimously in the name of the members of the Centre. The chairman, in conveying the same to Mr. Kempe, wished him good health and long life during his retirement.

The third meeting of the Session was held on February 3rd, 1913, when Mr. J. Crane read a paper on "Underground Construction." The paper proved full of interest and was illustrated by lantern-slides. A good discussion followed, and a vote of thanks to the lecturer concluded the meeting.

## NORTH MIDLAND CENTRE.

It has not been possible to commence the Session so early as could be desired, but a good programme has been arranged.

The first meeting was held at the Welbeck Hotel, Nottingham, on February 4th under the presidency of Mr. E. J. Eldridge, superintending engineer. Mr. W. J. Stubbs contributed an interesting and instructive paper on "Telephone Construction in Scandinavia and Finland," to the accompaniment of excellent lantern views. The lecture was followed in the evening by a most enjoyable smoking concert at which all ranks contributed their talent.

On March 4th a lecture was given by Mr. B. O. Anson on "Automatic Telephones." The lecture was the more interesting from the fact that working models were produced in illustration, and the largest attendance at a meeting of the institute was recorded.

A smoking concert followed which all enjoyed to the full.

Other items in the Session's programme are:

March, 1913.—"Wireless Telegraphy," Mr. H. M. Campbell.

April, 1913:—"The Slide Rule," Mr. V. H. Winson.



Digitized by Google

## SCOTLAND WEST DISTRICT.

Three meetings have been held this Session, and in each case it is pleasant to record that the attendance and discussion show an increased interest in the affairs of the Institution.

On December 9th a paper was read by Mr. Cameron on "Some practical Notes and Calculations on Building Construction."

Mr. Cameron has taken a special interest in this subject, and by means of calculations and diagrams he gave a very interesting summary of the methods of calculating the stresses and strains on various parts of a building.

Mr. Weaver read his paper on "The Economical Arrangement of Plant" on January 27th. The lecturer emphasised the desirability of engineers giving attention to the business side of their work and taking an interest in the principles underlying commercial matters. He also suggested that the contract officers of the commercial branch were in the best position to accurately anticipate the probable development in any particular locality, but, as transpired in the subsequent discussion, this was not the unanimous opinion of the meeting.

Mr. Weaver also dwelt on the maintenance and depreciation of various classes of plant and gave specific examples of the method of determining the most economical number and size of cables under different conditions, and also dealt with the renewal of open and underground plant.

The paper was of a highly instructive nature, and the discussion that followed showed the keen interest which it had aroused.

On February 24th Mr. Cunningham read a paper on "Small Automatic Pneumatic Plant for Post Offices."

Mr. Cunningham described plant which he had installed, and gave examples of the various troubles which had to be overcome before it worked satisfactorily. In this particular case the automatic apparatus replaced a hand installation and attention was drawn to the economic aspect of the case, and suggestions were made as to the feasibility of adapting the plant for the purpose of desiccating cables and also taking pressure tests of their condition.

---

## SCOTLAND EAST CENTRE.

A meeting was held on December 4th under the chairmanship of Mr. J. D. Taylor, at which Mr. R. J. Lawson read an interesting illustrated paper on "Underground Construction from the Point of View of Maintenance." The suggestions contained in the paper were of a practical nature, and evoked a good discussion. One point



Digitized by Google

mentioned was the desirability of using blue Staffordshire bricks for underground chambers; and it is noteworthy that the practice of using this class of brick has been reverted to after red wire cuts have been tried for fifteen years and found wanting. Any Centre on the lookout for a suitable paper to be re-delivered should not forget this paper. Mr. Taylor, who is heartily welcomed in his new capacity, took occasion to refer to the undoubted benefits that the Institution afford in promoting discussion on subjects of common interest.

# CORRESPONDENCE.

## WHEATSTONE WORKING IN CANADA.

*To the Editors of* THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

DEAR SIRS,—From his own point of view Mr. Murray is, no doubt, justified in his criticism of the paragraph in the above article to which he takes exception, but what I did was to exercise the right and privilege which everyone has of expressing an opinion based upon my own observation and the testimony of people whom I have no cause to regard as other than trustworthy.

The article in question is an extract from a paper read before what, I understood, was a mixed audience, that is, there were those present whose business is not closely concerned with technical telegraphy, and the speeds therefore were computed on the commonly understood basis of five letters per word, but this, I think, is somewhat immaterial so long as we have some method of comparison with the Canadian results.

I would like to disabuse Mr. Murray of the idea that I am prejudiced against his or any other printing system, or that I do not know of the advantages of the Baudot alphabet. I have expressed appreciation of these advantages more than once. At the same time, the advantages of the Morse code cannot be gainsaid, one of the chief of which is the fact that an expert telegraphist who takes an intelligent interest in affairs, fluctuations of markets, etc., will read a mutilated or distorted Morse slip, a condition which no printing telegraph is ever likely to fulfil.

I cannot do otherwise than accept the statements of the Russian Director General. On the other hand I am unable to reconcile their Wheatstone speeds with those we got on the Canadian line.

There was no intention to suggest that the Murray automatic results were not genuine. The suggestion was that at the time the



Digitized by Google

paper was read Wheatstone working was only entering on the systematic method in this country, and that, for many years, it had been too haphazard to show to any advantage.

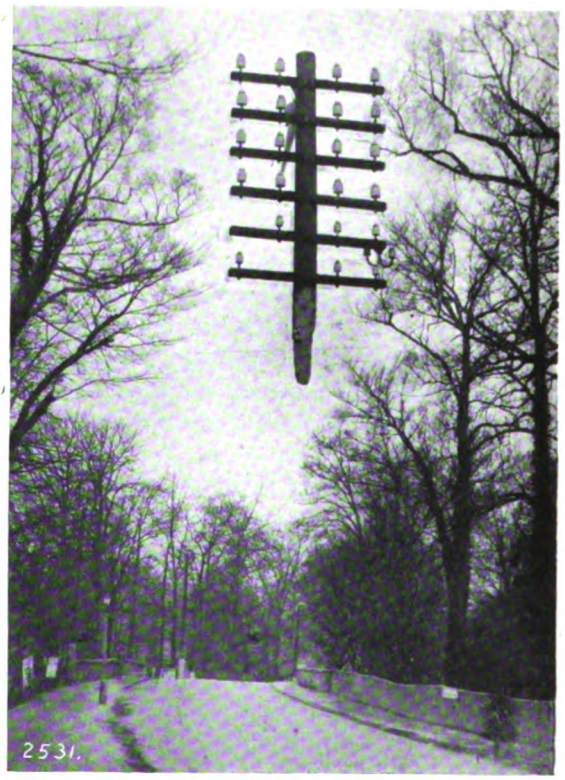
Mr. Murray truly says that when Wheatstone is associated with the Creed-receiving perforator, it ceases to be a single electro-magnet instrument, and therein I think there is a possibility of weakness. What is wanted is a system, free from complexity and consequent "nursing," such that when a fault occurs it will be possible to point to the seat of trouble and say, "The fault is there."

I am,

Llanfair, Yours faithfully,

*February* 19*th*, 1912. J. LOCKHART.

## THE SPECTRAL POLE.




"THE SPECTRAL POLE."

The accompanying photograph illustrates the dire results attending a collision between a motor omnibus and a telegraph post, at a



Digitized by Google

road crossing in Hendon Lane, N.W. A peculiar feature about this accident was that, although the pole was smashed just below the bottom arm, the arms and fittings transferred themselves bodily to the centre of the road, and there remained in position to carry on their useful work!

## BOOK NOTICE.

'The Engineer's Year-Book,' by H. R. Kempe, M.Inst.C.E., M.I.Mech.E., M.I.E.E., the Electrician to His Majesty's Post Office; formerly Principal Staff Engineer, Engineer-in-Chief's Office, General Post Office, London. (Publishers: Crosby, Lockwood & Son, Ludgate Hill, E.C. Price 12*s.* 6*d.*)

The twentieth edition of this excellent annual contains nearly 1600 pages and 1250 illustrations. Notable new sections have been added as follows:

"Legal Notes for Engineers," by W. Valentine Ball, M.A., Barrister-at-Law. "Roads and Streets," by Reginal Ryves, A.M.I.C.E. "Steam Turbine Practice," by H. L. Guy, A.M.I.C.E. "Electric Traction," by Prof. Carus Wilson, M.I.E.E. "Waterworks Engineering," by R. F. Middleton, A.M.I.C.E. "Acetylene Gas and its Applications," by Prof. Vivian B. Lewes, F.I.C., F.C.S. "Marine Diesel Engines," by A. P. Chalkley, A.M.I.C.E. "Surface Combustion," by Percy St. G. Kirke, M.A., A.M.I.C.E. "Quayside Appliances; Dredging; Rock Removal, etc.," by Brysson Cunningham, A.M.I.C.E., together with "A Summary of Engineering Progress during 1912" (the latter by arrangement with the Editor of the 'Times Engineering Supplement.).

The following Institutions have kindly given official permission that extracts from their proceedings may be published in the 'Year-Book': The Institution of Civil Engineers, The Institution of Mechanical Engineers, The Institution of Electrical Engineers, The Institution of Naval Architects; a privilege which has enabled valuable facts and data to be embodied in the work in a handy and easily accessible form.

The Engineering Standards Committee has also authorised the publication in the work of abstracts of their specifications and recommendations.

It is unnecessary for us to say anything in commendation of Mr. Kempe's excellent 'Year-Book.' Its virtues are well known, and it can be seen on the desk of every up-to-date engineer. Its comprehensive pages include almost every subject in which engineers are professionally interested, and it is justly regarded as one of the standard annual publications.



Digitized by Google

## ERRATA.

In the description of "Silencer No. 3," which appeared on p. 434, vol. 5, Part 4, the figures 1 and 5 were inadvertently crossed.

## OBITUARY.

### JOHN JENKIN.

IT is little more than three years since we chronicled in these pages the retirement from the service of Mr. John Jenkin, Superintending Engineer of the Eastern District. We regret we have to announce that his death took place at Cambridge, after a long illness, on March 11th, 1913.

We lose in Mr. Jenkin one of the few remaining links with the old telegraph companies. He entered the service of the Electric and International Telegraph Company in 1858, and was transferred to the Post Office in 1870. His administrative ability was quickly recognised by his new chief, Mr. Shaw, Divisional Engineer, to whom he was appointed Assistant. On the re-organisation in 1878, when the old "divisions" were mapped out into "districts," Mr. Graves, then Engineer-in-Chief, appointed Mr. Jenkin a relief Superintending Engineer, but shortly afterwards Mr. Jenkin effected a change with Mr. E. Ashton, and settled down at Cambridge in permanent charge of the Eastern District, which position he continued to occupy until his retirement in the autumn of 1909.

The outstanding feature, to those who knew Mr. Jenkin best, was his absolute devotion to duty. No trouble was too great, no time was too long to devote to any case requiring his official attention. The fact that he kept pencil and paper at his bedside was a true indication of the man, and what he considered to be his duty was the standard by which he judged others. As a representative of the Department in dealing with the public he was probably unrivalled. Rarely did he meet with failure in anything he undertook. Perhaps the longest and most trying task was in connection with the public wayleaves for that portion of the East Coast line between Hatfield and Stevenage, which was built in connection with the introduction of the "Sixpenny Tariff." The route passing through a high-class residential district, every possible objection was raised, public meetings were held, and an attempt was made to obtain an injunction, but just when it was believed that each party had said its last word without actually taking legal proceedings, the good people of Stevenage awoke one morning and were amazed at



Digitized by Google

finding a nice straight line of telegraphs down the wide main thoroughfare of the village. Needless to say, every effort was made to appease the wrath of the numerous property owners, and each one seemed to have his own idea as to how a telegraph line might be made beautiful. There were short sections of green poles, chocolate poles, white poles, dark-green poles, stone-colour poles; poles with white insulators and poles with brown insulators; poles with machine-turned arms, and creosoted poles with square arms. These sections of poles enabled one to form an idea as to the boundary of each property, and to some extent the temperament of the owners. Each objector considered he had largely succeeded in gaining his point, and all were afterwards on the best of terms with Mr. Jenkin, for no one could avoid being charmed by his engaging manner, fine presence and infinite tact. To the end of his official career Mr. Jenkins' interest and enthusiasm in matters departmental were unabated. He lived a strenuous life, and required of his subordinates that they should do the same. He was thought difficult to please, but that was because he had a very high standard; and if expressions of appreciation were few, they were generous when opportunities came to recommend any for promotion who had done their best.

The memory of Mr. Jenkin will always be green in the minds of those who were intimately associated with him, and his absolute unselfishness and devotion to duty afforded a magnificent example to those who were privileged to serve under him. Like most of the old school of superintending engineers, Mr. Jenkin had no hobby, the work of the district occupying the whole of his time, but, during the long summer evenings, the little leisure he allowed himself was spent in the well-kept and spacious grounds around his house, which was situated on the outskirts of Cambridge.

J. W. G.
E. T. T.

---

# STAFF CHANGES.

## POST OFFICE ENGINEERING DEPARTMENT.

PROMOTIONS.

| Name. | Appointment. | | Date from which to take effect. |
|---|---|---|---|
| | Rank. | District. | |
| Shaughnessy, E. H. . . | Staff Engr. | E. in C.O. | 14 : 2 : 13 |
| Booth, A. C. . . . | Ditto | Ditto | 14 : 2 : 13 |
| Parkinson, F. S. . . . | Asst. Supt. Engr. | S. Lancs. | 6 : 1 : 13 |



Digitized by Google

## TRANSFERS.

| Name. | Former. | | Present. | | Date from which to take effect. |
|---|---|---|---|---|---|
| | Rank. | District. | Rank. | District. | |
| Gillespie, J. T. | Exec. Engr. | S. Mid. | Exec. Engr. | Sc. E. | 31 : 12 : 12 |
| Newlands, J. H. | Asst. Engr. | N. W. | Asst. Engr. | E. in C.O. | 1 : 1 : 13 |
| Ashton, H. E. | ,, | S. Wa. | ,, | S. E. | 5 : 1 : 13 |
| Childs, P. J. | ,, | E. in C.O. | ,, | London | 1 : 2 : 13 |
| McCormack, W. | ,, | London | ,, | N. W. | 5 : 1 : 13 |
| Mackenzie, J. | Engr. 2nd Class | N. | Engr 2nd C ss | S. Wa. | 7 : 11 : 12 |
| Moller, O. P. | ,, | London | ,, | E. in C.O. | 1 : 2 : 13 |
| Elliott, A. | Chief Inspector | N. Mid. | Chief Inspector | S. Wa. | 1 : 1 : 13 |
| Brientini, J. | Junr. Engr. | E. in C.O. | Junr. Engr. | London Testg. Bch. | 8 : 12 : 12 |

## RETIREMENTS.

| Name. | Former. | | Particulars. | Date from which to take effect. |
|---|---|---|---|---|
| | Rank. | District. | | |
| Kempe, H. R. | Electrician to the Post Office | E. in C.O. | Superannuated | 31 : 12 : 12 |
| Jones, A. P. | 3rd Cl. Clk. | London. | Transfered to Nat. Health Insurance Com. | 9 : 12 : 12 |

## DEATHS.

| Name. | Rank. | District. | Date. |
|---|---|---|---|
| Jenkin, J. | Ex-Supt. Engr. | — | 11 : 3 : 13 |
| Fray, W. C. | Asst. Engr. | E. in C.O. | 6 : 3 : 13 |

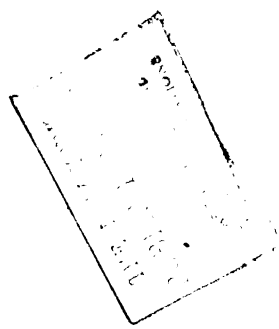
## COMMUNICATIONS.

All Remittances and Agents' Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, G.P.O. West, London, E.C.

Editorial Communications and Correspondence should be addressed to Mr. D. H. KENNEDY, Norbiggin, 26, Oakley Avenue, Ealing, W. (Telephone, Ealing 1000.)



Digitized by Google



Digitized by Google

## TRANSFERS.

| Name. | Former. | | Present. | | Date from which to take effect. |
|---|---|---|---|---|---|
| | Rank. | District. | Rank. | District. | |
| Gillespie, J. T. | Exec. Engr. | S. Mid. | Exec. Engr. | Sc. E. | 31 : 12 : 12 |
| Newlands, J. H. | Asst. Engr. | N. W. | Asst. Engr. | E. in C.O. | 1 : 1 : 13 |
| Ashton, H. E. | ,, | S. Wa. | ,, | S. E. | 5 : 1 : 13 |
| Childs, P. J. | ,, | E. in C.O. | ,, | London | 1 : 2 : 13 |
| McCormack, W. | ,, | London | ,, | N. W. | 5 : 1 : 13 |
| Mackenzie, J. | Engr. 2nd Class | N. | Engr nd C .ss | S. Wa. | 7 : 11 : 12 |
| Moller, O. P. | ,, | London | ,, | E. in C.O. | 1 : 2 : 13 |
| Elliott, A. | Chief Inspector | N. Mid. | Chief Inspector | S. Wa. | 1 : 1 : 13 |
| Brientini, J. | Junr. Engr. | E. in C.O. | Junr. Engr. | London Testg. Bch. | 8 : 12 : 12 |

## RETIREMENTS.

| Name. | Former. | | Particulars. | Date from which to take effect. |
|---|---|---|---|---|
| | Rank. | District. | | |
| Kempe, H. R. | Electrician to the Post Office | E. in C.O. | Superannuated | 31 : 12 : 12 |
| Jones, A. P. | 3rd Cl. Clk. | London. | Transfered to Nat. Health Insurance Com. | 9 : 12 : 12 |

## DEATHS.

| Name. | Rank. | District. | Date. |
|---|---|---|---|
| Jenkin, J. | Ex-Supt. Engr. | — | 11 : 3 : 13 |
| Fray, W. C. | Asst. Engr. | E. in C.O. | 6 : 3 : 13 |

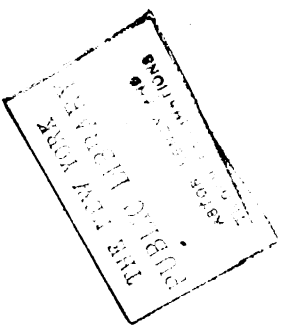
## COMMUNICATIONS.

All Remittances and Agents' Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, G.P.O. West, London, E.C.

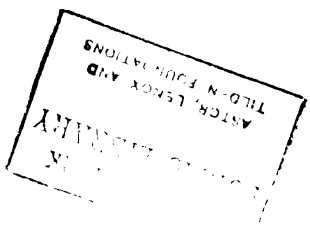
Editorial Communications and Correspondence should be addressed to Mr. D. H. KENNEDY, Norbiggin, 26, Oakley Avenue, Ealing, W. (Telephone, Ealing 1000.)



Digitized by Google


THE NEW YORK
PUBLIC LIBRARY

Digitized by Google




*tary).*

Digitized by Google

THE
Post Office Electrical Engineers' Journal

# THE LORIMER AUTOMATIC EXCHANGE AT HEREFORD.

By W. J. Bailey, A.M.I.E.E.

A 32-volt automatic C.B. exchange equipment of the Lorimer type, manufactured by the Canadian Machine Telephone Company, of Toronto, Canada, has been installed at Hereford.

The local traffic at this western cathedral city is over 90 per cent. of the total traffic, and it is, therefore, a very suitable place for an automatic system.

The present equipment is for 500 lines, and, as shown in the lay-out plan 4, consists of five switching units. Each unit is equipped with apparatus for 100 lines as follows: 100 line relays, 100 meters, 100 cut-off relays, 10 sequence relays, 1 decimal controller switch, 1 division starter switch, and 7 connective divisions, each comprising 5 switches, viz. "A," "B," signal controller, interconnector, and pilot, as shown in 1 and 2, upon which latter are also indicated the functions of the various items.

A general view of the five switching units is given in 3.

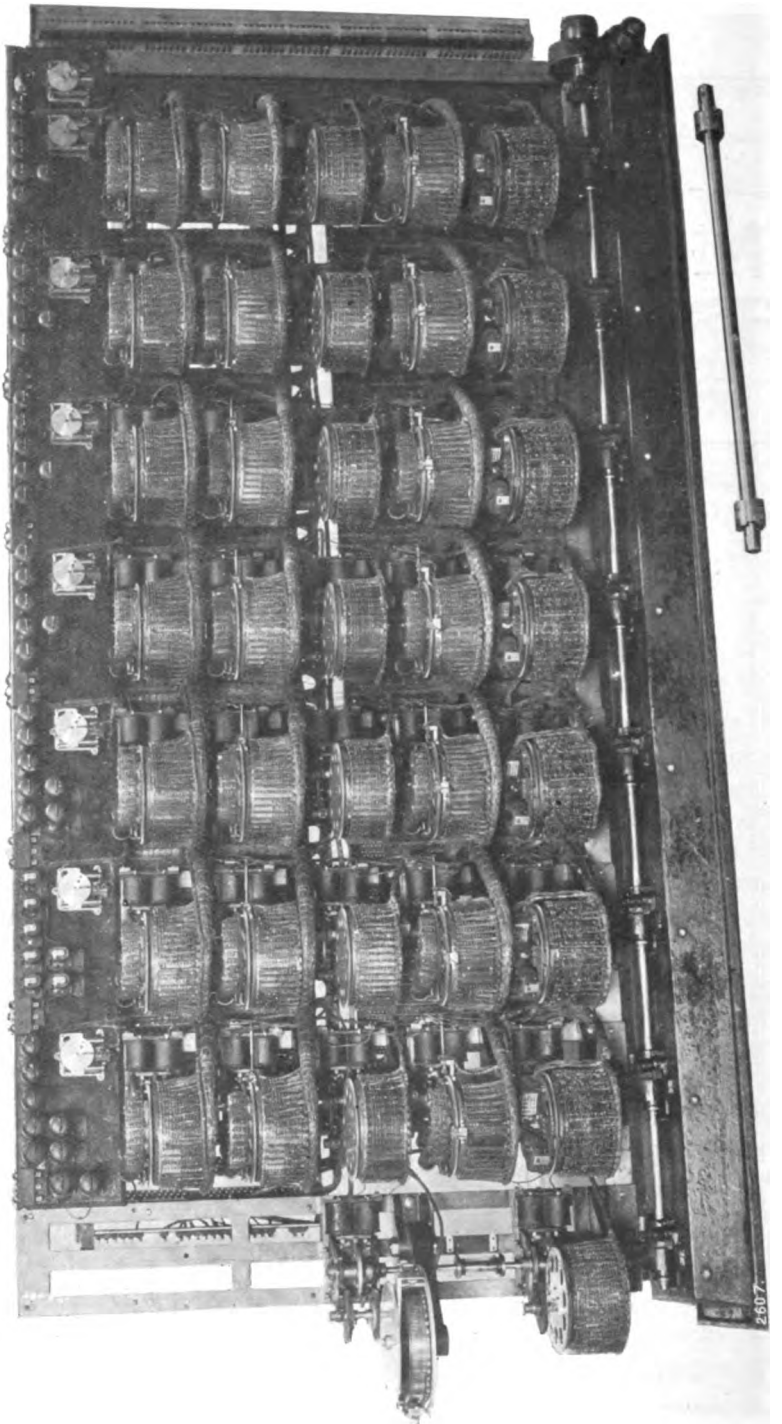
Provision is made for seven simultaneous outgoing and seven simultaneous incoming calls per 100 subscribers, and this is considered sufficient to meet the traffic requirements at Hereford. At present, however, the maximum number of working lines per switchboard will not exceed eighty.

*The system of numbering is as follows:*

1000 to 1999 for ordinary straight lines.



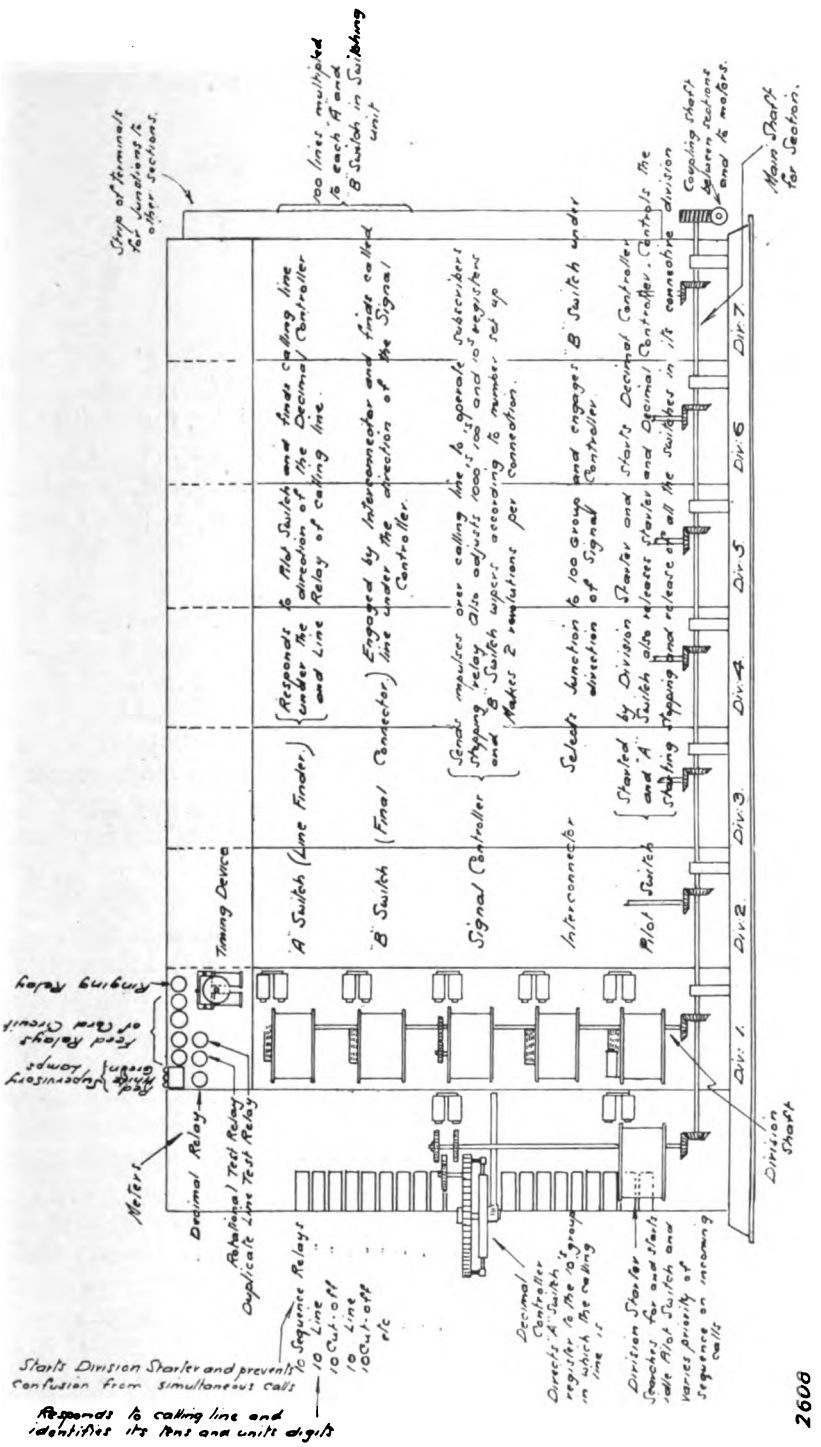
Digitized by Google



I.—Lorimer 100-Line Switching Unit (Line Relays and Meters omitted).



Digitized by Google




2.—100-Line Switching Unit with 7 Connective Divisions or Cord Circuits.

2608

668281



Digitized by Google

| | |
|---|---|
| 2000 to 2999<br>3000 to 3999<br>4000 to 4999<br>5000 to 5999<br>6000 to 6999 | five-party line circuits, but number of working stations will not exceed four. |
| 7000 to 7999<br>8000 to 8999 | two-party line circuits. |
| 0000<br>1000<br>9999 | trouble lines. |

The four-figure system is necessary for the provision of party line code signalling, otherwise only three figures would be required.

As arranged for Hereford, the first numeral, *i.e.* the thousands digit, determines the ringing signal which is to be applied to the called line. Ordinary straight lines begin with 1, and, as will be seen later, this signal adjusts the ringing register on the pilot switch to send out ordinary loop pulsations.

For five party line circuits the first digits are 2, 3, 4, 5 or 6, and these cause the adjustment of the ringing register to send out 2, 3, 4, 5 or 1 rings respectively. Thus on each of these party lines five directory numbers are possible, for example, 2345, 3345, 4345, 5345 and 6345. The number of stations on one line, however, is not allowed to exceed four. Assuming the first four numbers to be appropriated, and that one of them is removed for any reason, another station can be added in its place immediately and given the previously unoccupied directory number. The new-comer is, therefore, not annoyed by calls for the station which has just been removed from the line.

For two-party selective ringing lines the thousands digits are seven or eight, and these signals cause the adjustment of the ringing register to send out one ring on either the "A" or "B" line.

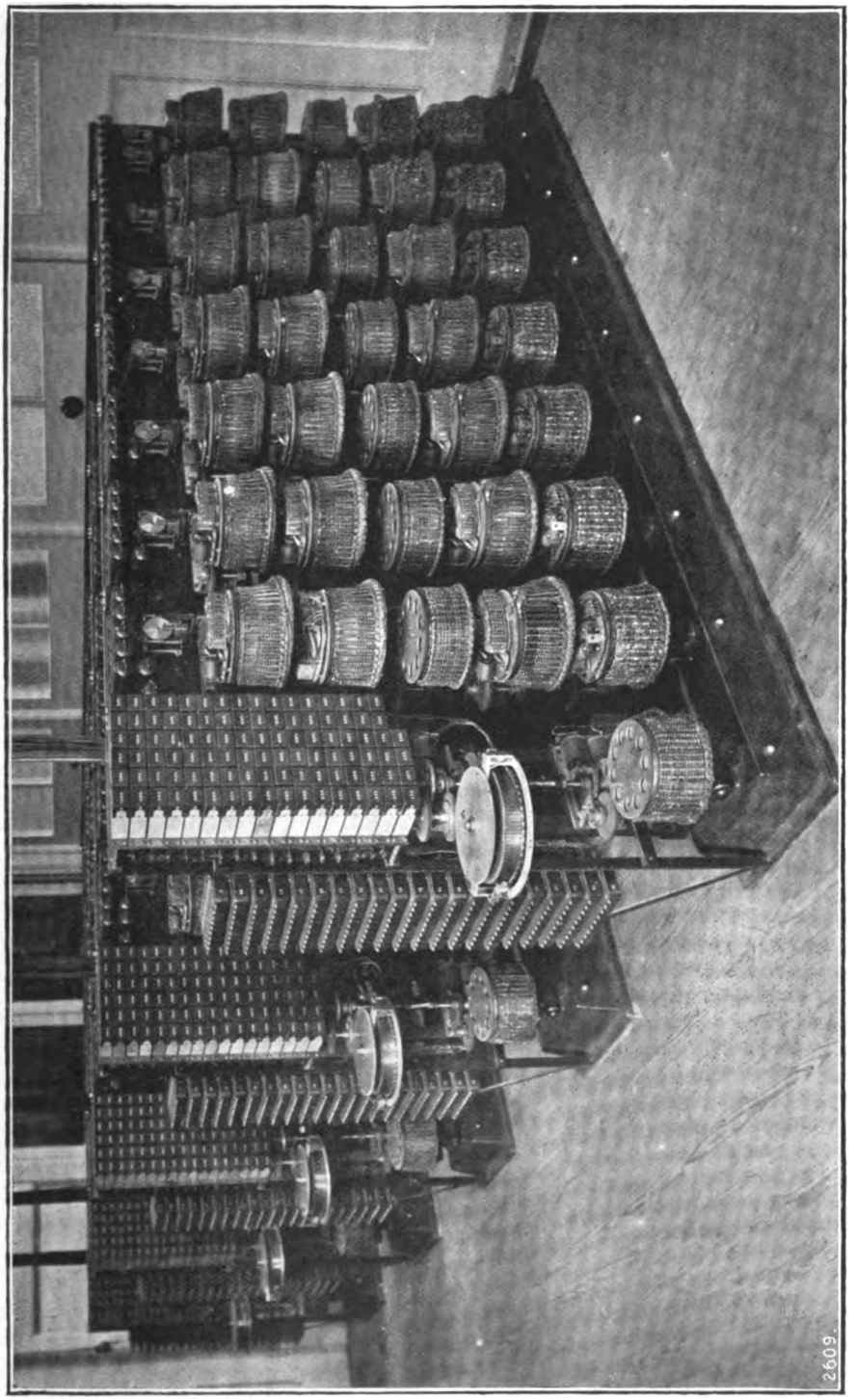
An ordinary straight subscriber's line can become either a four- or two-party line by merely altering its thousands number from 1 to 2, 3, 4, 5 or 6, or from 1 to 7 or 8, the hundreds, tens and units digits remaining as before.

The numbering of the trouble lines is controlled by the fact that an earth fault on either the "A" or "B" line or both may operate the line relay, and cause the faulty line to be picked up and joined through to the signal controller. An earth on the "B" line or both will produce the same train of switching operations as though a call had been turned in for 0000 or 1000. An earth on the "A" line only will cause the adjustment for ringing up No. 9999.

A consideration of the Lorimer system should prove instructive and interesting to telephone engineers, inasmuch as it differs very materially in many respects from that of the Strowger system



Digitized by Google



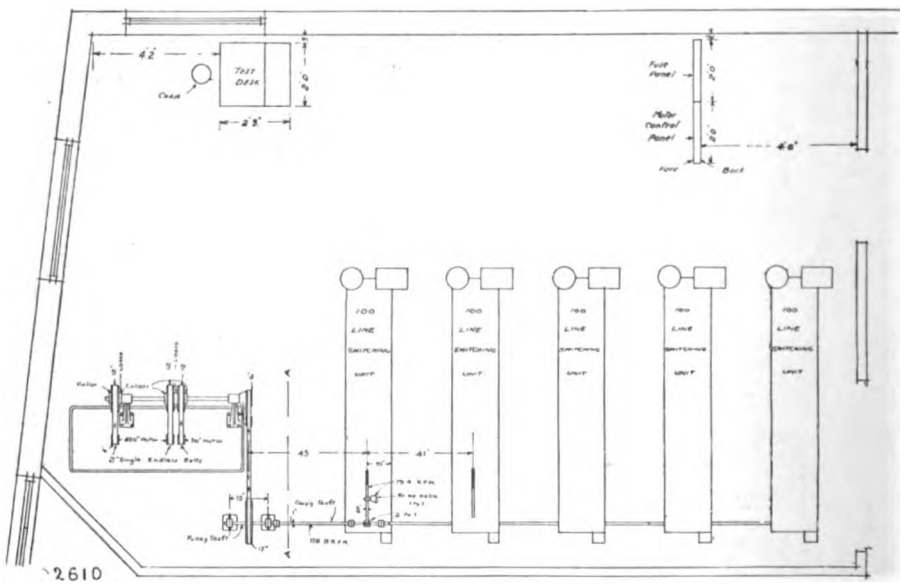

3.—General View of Hereford Automatic Switching Equipment.



Digitized by Google

described in the POST OFFICE ELECTRICAL ENGINEERS' JOURNAL, vol. v, Part II, July, 1912, and is an instance that there is more than one way of doing a thing, although of course each inventor is prepared to contend that his invention is the more excellent way.

So far as this article is concerned no attempt will be made to settle the claims of the rivals, and those comparisons which might come within the class proverbially considered as odious will be avoided. We give the stranger as cordial a welcome to this country as we gave the Strowger system, and as we can now form a closer acquaintance with her than when she was on the other side of the




4.—HEREFORD EXCHANGE LAY OUT PLAN.

Atlantic, we shall be able to determine what the mechanical girl can do, and how well she can do it.

This article, which is mainly descriptive and not a critical review, is divided into three parts:

(1) General.
(2) Apparatus details.
(3) Circuit details.

It is assumed that the reader has some knowledge of what is required in an automatic exchange system.

## 1. General.

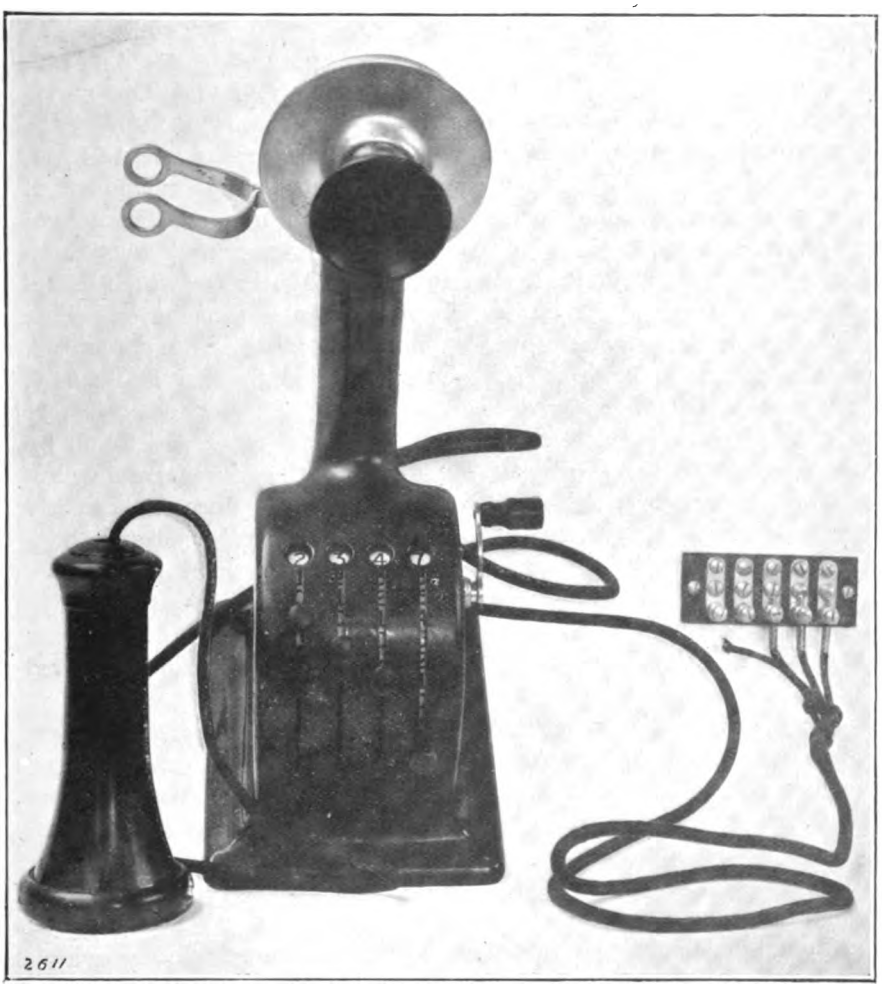
The essential features of the Lorimer system are as follows:

(A) *The subscriber's set* (5 and 6) is fitted with a number-setting



Digitized by Google

mechanism, having four levers under the control of the subscriber. These levers can be moved in the vertical plane of their individual slots, and according to their position they adjust the internal mechanism, and at the same time set up the number visibly before




5.—LORIMER TABLE TELEPHONE, WITH LEVERS SET TO CALL NO. 2347.

the subscriber. Its internal mechanism is under the entire control of the Exchange apparatus.

To set up a call, the subscriber first adjusts his levers to the required number; second, turns the crank handle one revolution; and third, lifts his receiver.

As the call passes forward the internal mechanism is operated, and when the clicking ceases, the subscriber's receiver which is out



Digitized by Google

of circuit during the progress of the call, is joined up, and if no busy tone is received he waits until the called party replies. If he should get the wrong number he will check the visible numbers with those in the directory. The levers and numbers are not affected by the Exchange signalling; they have no normal position, but remain wherever placed by the subscriber.

(B) *The Exchange switching apparatus* is operated by coupling it to a constantly moving shaft shown in **1**, **2**, **13**, and **14**. The movements of the switches are therefore uniform and not under the control of any variable signalling apparatus at the subscriber's end, but, as already stated, the switches actually control the movement of the subscriber's calling device. This question of power drive by a universal instead of an individual motor is a matter on which automatic experts hold different opinions. The motor which drives the shaft is generally used for driving the ringing machines. This shaft is now the only continuously moving portion of the apparatus, as the decimal indicator has been superseded by line and cut-off relays.

(C) *The line of the calling subscriber is searched after* and found by the wipers of the "A" or line-finder switch of the connective division which is attending to the call. The calling line does not directly find a disengaged switching apparatus, but a disengaged switching apparatus is brought into action to find the calling line.

(D) *The private and line banks are not separated* but fitted in adjacent positions in the same cylinder as shown at *AL.* 1, *AL.* 2; *AL.* 3 in **28**. These cylinders also contain signal and battery feed tags.

(E) *An individual wiper is provided for each level of contacts.* There is no combined "up and around" movement nor "around and up" as in certain other systems. In the "A," "B" and Inter-connector switches there are actually four wipers per row, spaced out horizontally 90° apart.

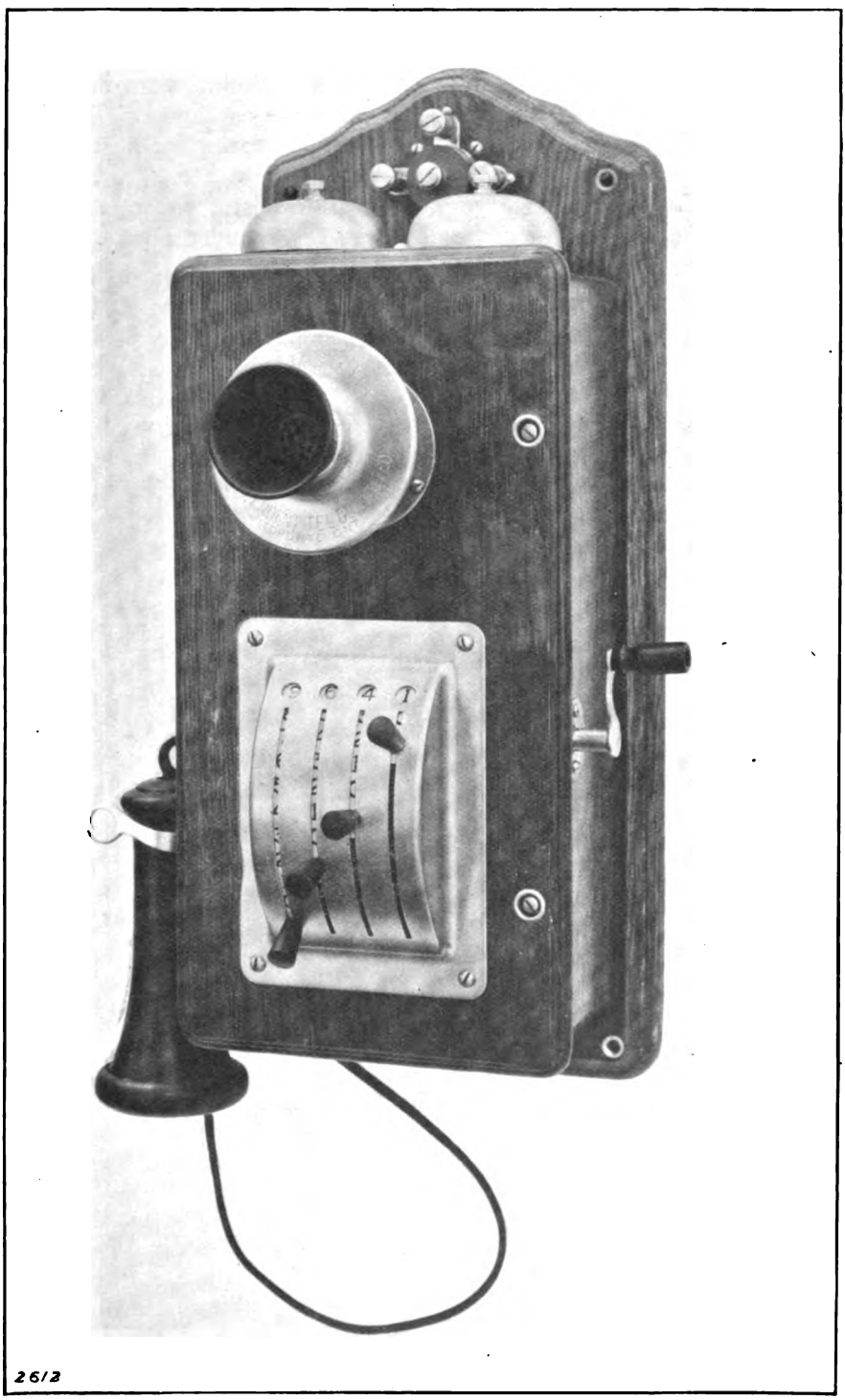
Some of the wipers in the various switches are paired vertically, others horizontally, but in whatever combination they may be arranged or however spaced, the wipers in the same cylinder switch are each fitted to the common gearing of that switch and move together, making contact with the points in their own level as they pass along.

The cylinder wipers rotate in one direction only and pass from normal to active positions and return from active to their normal position in a clock-wise direction, thus performing a complete revolution in a horizontal plane.

Here again expert opinion may be divided concerning the principle of providing individual wipers for each level and also their movement in one direction instead of to and fro.



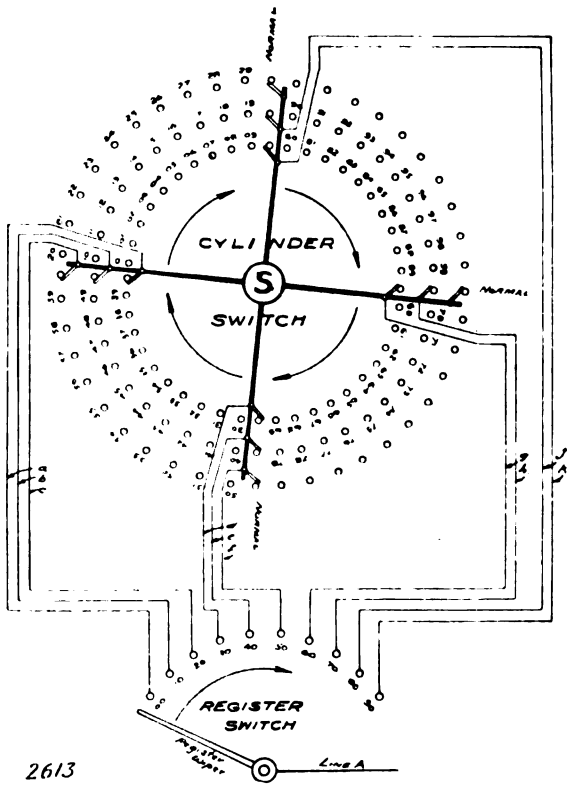
Digitized by Google




6.—Lorimer Wall Telephone, with Levers set to call No. 9641. 105

Digitized by Google

7 illustrates the principle of the cylinder and register switches which form a complete "A" or "B" connector switch, and also may be used to represent the interconnector switch. The hundred circuits are distributed over the four quadrants as shown. The ten cylinder wipers are fixed to the common gearing "S," and are individually connected by means of conductors *a, b, c, d, e, f, g, h, j and k* to the register bank contacts. The register wiper is on its own gearing and moves independently of the cylinder wipers.




7.—Principle of Cylinder and Register Switches.

To connect calling line "A" to No. 89, the register wiper is moved to its bank contact 80 and the cylinder gearing "*S*" is independently rotated until the ten wipers are on the cylinder contact points having 9 as their units digit. "A" is thus connected *viâ* 80, "J" and No. 80 cylinder wiper to 89.

A similar action is performed if 89 is the calling line which has to be found by the wipers and connected through to the junction line "A." It will thus be seen that a vertical movement is not



Digitized by Google

required with such an arrangement. The actual construction of the combined cylinder and register switches is shown in **15** to **25**.

(F) *A time-limiting device* (**38**) is provided which can be adjusted to limit conversations to a definite length of time, at the expiration of which, if not already completed and cleared, the connection will be broken automatically and a fresh call will be necessary to continue the conversation. The extent of the time-limit can be varied by rearranging the gearing.

This device is also brought into operation if a connective division is faulty, and does not take up a call. It is also of service in preventing one subscriber holding up another by failing to restore his receiver.

The advocates of the Lorimer system claim the following points in its favour: A number-setting machine appeals to the nervous caller in a big system. He sets up the directory number as a whole visibly before him, and can check it before turning the crank to call up the Exchange.

If the maximum percentage of simultaneous calls is in progress the next caller is forced to wait until there is an idle division available, when the connection demanded will be given by the Exchange in the order of priority of call. Therefore he need not make repeated attempts which are bound to be futile for the time being. He can, however, alter his levers for a fresh number if he should so desire. If he cannot wait during a very busy period and wishes to give up the call he restores the receiver, and when his turn arrives the Exchange apparatus will release his mechanism, restoring it to normal. In the meantime, if he is wanted, the ringing current operates his mechanism and restores it to normal, so that he is able to receive the call.

A subscriber whose calls are mostly for one particular number will generally find his levers at that number, and all that he then need do is to turn his crank handle and lift his receiver. It may, perhaps, be mentioned here that the Canadian Telephone Company, by locking the levers at definite numbers, are able to quote special rates to those subscribers whose calls are to one subscriber only, thus giving a private line service. It is also possible to block the use of certain numbers, so that subscribers on a restricted service are unable to call up those numbers.

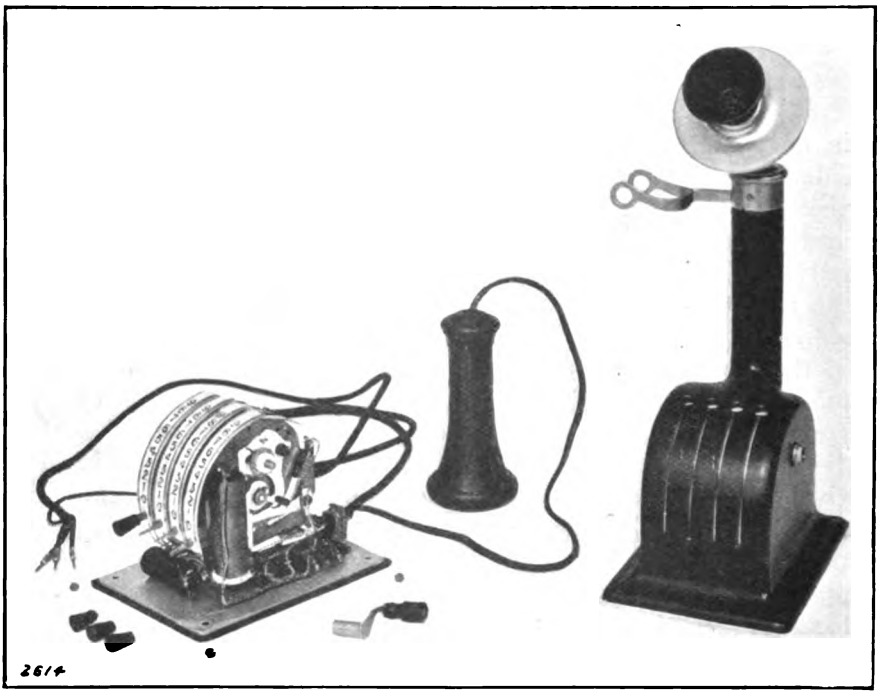
How far these arguments will appeal to the British public remains to be seen. It may be found that the telephone users in this country do not need the number-setting machine with its somewhat complicated mechanism. The task will then be imposed upon the engineers of the Lorimer type of exchange to modify their arrangements to suit the dial-switch. There is also the question of floor-space, and doubtless the Lorimer engineers



Digitized by Google

will be able to reduce the floor-space required per unit when reconsidering the design of their plant.

Hitherto on all Lorimer 100-line switching units there has been fitted, in addition to the division-starter and decimal controller, one decimal indicator common to each 100 lines. The brush of the decimal indicator was kept in continuous rotation over a ring of segments, to which the subscriber's lines were connected. Its function was to test each of the 100 lines once every three seconds,



8.—Lorimer Table Telephone with Calling Mechanism removed from Cover.

to ascertain if it had a call set up. When such a calling line was found the brush stopped on that segment. This pause was only momentary, however, for as soon as the calling line had been picked up by a connective division the brushes moved on again, hunting for other calling lines. Thus, it worked hard when there was nothing to do, and rested when there was something to be done. At night time and slack periods this was a waste of energy. At Hereford the decimal indicator has been replaced by line and cut-off relays.

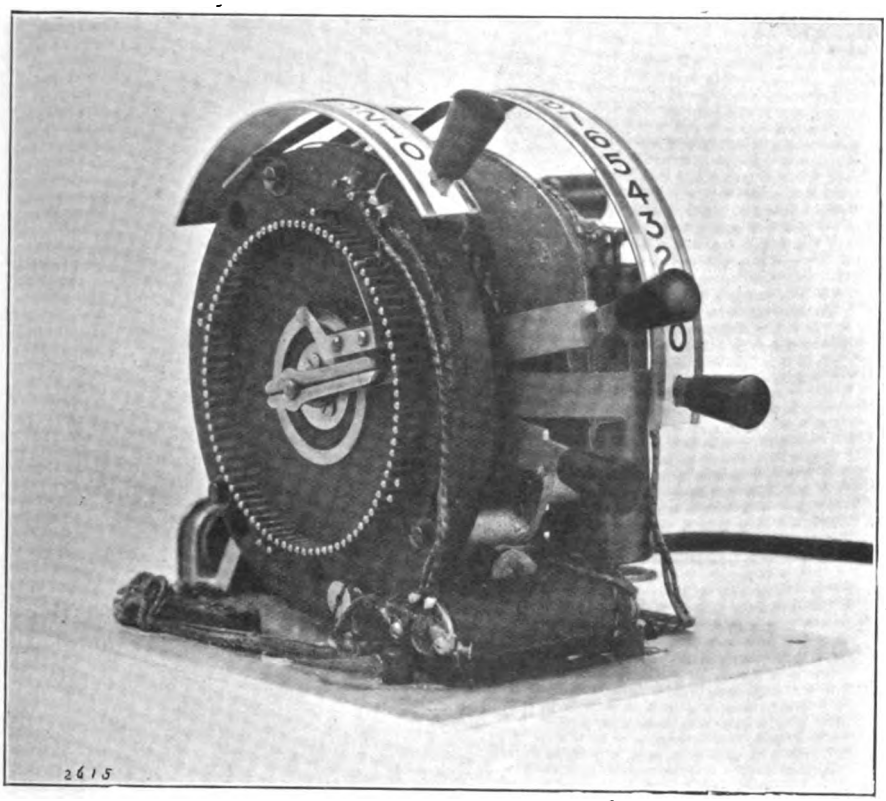
Other improvements—amongst which is the elimination of the decimal controller switch—have also been arranged for by the Lorimer engineers.



Digitized by Google

Stated in general terms, the Lorimer system, in its present stage of development at Hereford, is as follows:

The subscribers' lines are connected to the line relays through the break contacts of cut-off relays as in a C.B. manual system. The lines are also multipled direct to their individual tags on the 7 line finder and 7 final switches common to 99 other lines in the same 100 group. These switches correspond respectively to the "A" and



9.—Lorimer Calling Mechanism (Two Curved Number Strips removed).

"B" positions of a manual switchboard. The line relays are grouped in hundreds and arranged in ten rows of ten in numerical order, as in **36** and **45**. The relays in the same horizontal row have the same tens digit, and those in the same vertical row have the same units digit. Each vertical row is electrically combined with one sequence relay. The ten sequence relays are on the top row, and their left-hand contacts are joined in series as in **36**, and so connected with the division starter contacts that they form a chain of contacts which can be varied in order, as will be shown later. The function of the sequence relay is to prevent confusion, which other-



Digitized by Google

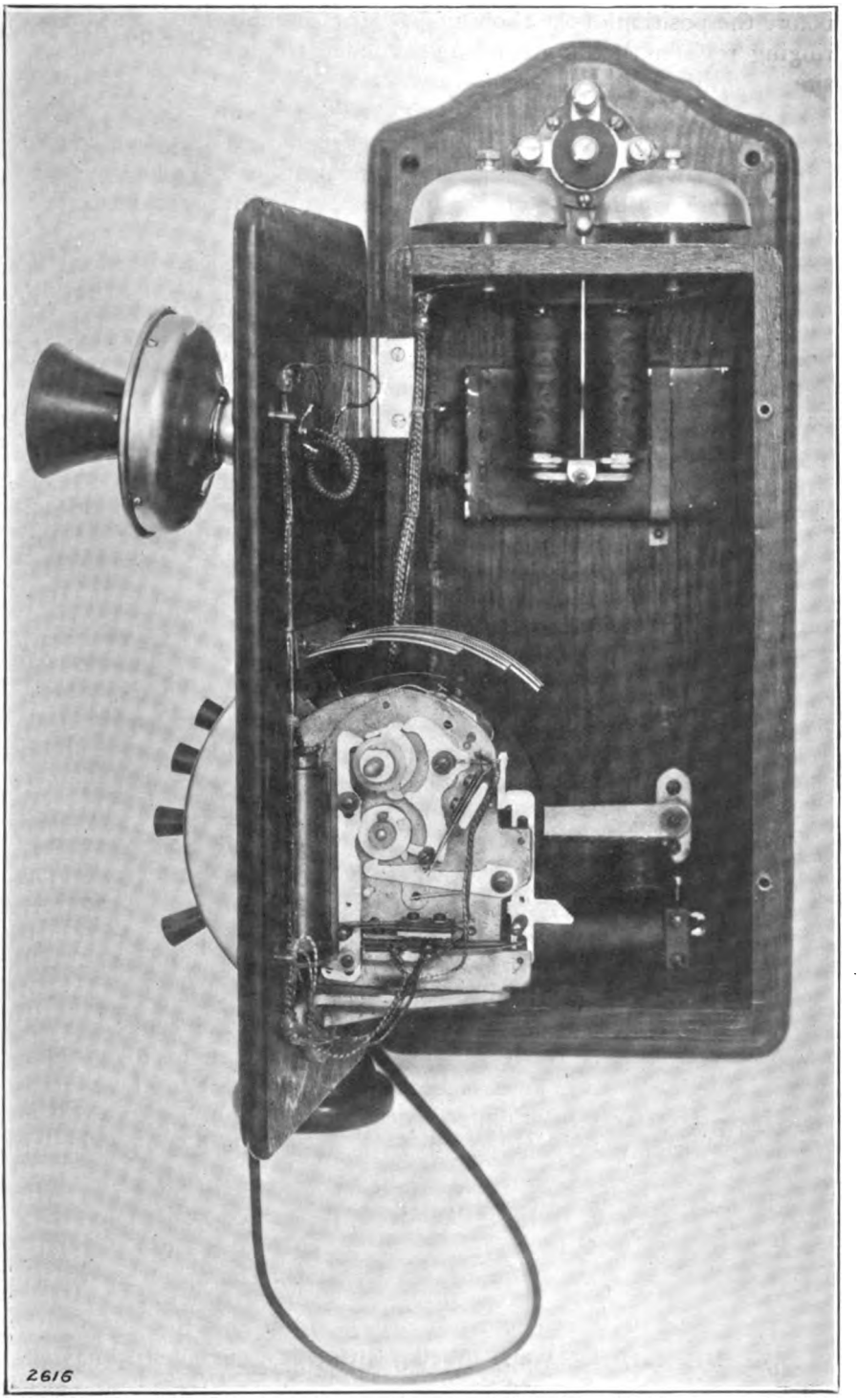
wise might arise from simultaneous calls. Common to each 10 subscribers' lines having the same units digit is a "units" identifying wire associated with the contacts of the 10 line relays as in **45** at *L* 30-*L* 39. Common to each 10 subscribers' lines having the same tens digit is a tens identifying wire associated with the contacts of the 10 line relays as at *L* 10–L 19. Thus from each group of 100 line relays there are 10 "units" identifying wires terminating in tags at the "A" switch **39** at *A* 0-*A* 9, and 10 "tens" identifying wires terminating at the decimal controller switch **46** *D* 0–*D* 9. The latter switch together with the division starter are common to one line switching unit of 100 lines. The relative positions and functions of the different switches are given in **2**, the assembly elevation already referred to.

Say line No. 1714 sets up a call. Its line relay in the 1–700 group operates, and with it the sequence relay 04 in **28**, which diagram will be explained more fully later. The No. 4 units and the No. 1 tens identifying wires are earthed, thus signifying that a line having 4 as its "units" digit and 1 as its "tens" digit is calling. The sequence relay starts the division starter hunting for an idle connective division, and when one is found the pilot-switch is energised and this brings in the "A" switch to find the calling line. Simultaneously with this action the *decimal controller* is operated; its brushes move forward, and on reaching the earthed tens identifying wire are in turn earthed by the operation of the decimal relay. These brushes passing on cause two positive impulses to be sent over *D*–11 wire to the tens register, electrically informing it that the tens digit of the calling line is 1. The register wipers "*D*" move forward to the second tens contacts "*C*." The pilot-switch also operates the line-finder clutch magnet and keeps it energised until all the cylinder wipers reach the No. 4 units tags, when the circuit of the feed relay 1 is closed by finding earth on the No. 4 units identifying wire and so breaks the line-finder clutch magnet circuit. The calling line is now through *viâ* "*A*," "*B*," "*C*," "*D*," "*E*" and "*F*" to the pilot switch, and the division starter and decimal controller are free to attend to another call. The calling line is also guarded against other calls. The time taken to find the calling line is 1¼ seconds.

The pilot-switch next brings the signal controller switch into action to ascertain the numbers set up at the calling telephone and to adjust the ringing and interconnector registers as in **29**, which is to be more fully described later. During the passage of the wipers over the first half of the signal controller cylinder, impulses are sent over line 2 of the subscribers' circuit, and these operate his mechanism. While the impulses are passing, feed relay 1 tests the second wire which is connected to the subscriber's moving brush, and the ringing register records the number of impulses sent out



Digitized by Google




**10.**—LORIMER WALL TELEPHONE, SHOWING RIGHT-HAND VIEW OF CALLING MECHANISM.



Digitized by Google

before the position of the thousands lever is found by the brush. The ringing register thus joins up the particular ringing commutator for ringing up the called subscriber.

The interconnector register is next brought into circuit. The signal controller and test relay repeat their former operation as the wipers pass over the second half of the controller cylinder, and the *interconnector register* records the number of impulses sent out before the position of the hundreds lever is found.

The wipers of the *interconnector switch* proceed to hunt for a junction line to this hundred group as in **30**. If the wanted line is in the same hundred group as the calling subscriber, the interconnector wipers may pick up any idle " B" switch in its own group, but not necessarily the one in its own vertical division, which may have already been engaged by some other caller.

When an idle " B " switch of the particular group is found, a signal is given to the pilot switch, which moves to position 4, and in turn signals the signal controller to pass to its normal position, which when reached causes a further impulse to the pilot, whose wipers are then moved to position No. 5. The signal controller and test-relay repeat their previous operations in order to ascertain the tens and units digits set up, and the wipers of the " B " switch come to rest on the called line as in **31**. The signal controller pauses while the pilot moves from position 5 to 6 and makes the busy test. The signal controller is then signalled by the busy test-relay, and resumes its normal position, completing its operations by signalling the pilot to move to position 7, where the pilot makes a momentary pause before moving to the first ringing position to ensure that no distorted ringing signal shall go out to the called line. After one code ring it moves to position 9, where, if the caller's receiver is off, showing that it is a proper call, it moves to the second ringing position and rings until the called station replies. When the called station lifts his receiver the pilot-switch moves to the talk position, operates the meter, and the calling line is now through.

On the restoration of the receiver the pilot-switch moves to its release position, and the various switches are brought to normal. The subscribers' lines are cleared immediately the pilot-switch moves to the release position, so that a fresh call can be set up and turned in within one second of the restoration of the calling station's receiver.

* * *

### 2. Apparatus Details.

The subscriber's set is illustrated in **5** and **6**.

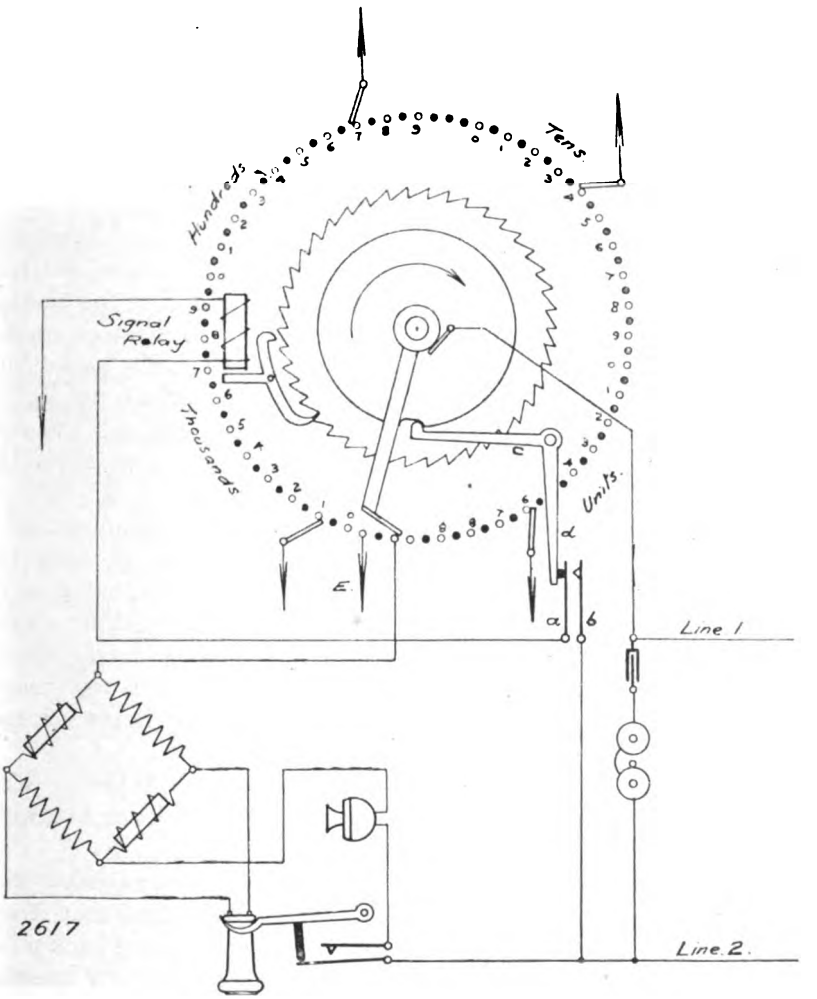
Fixed to each lever and moving with it is a curved strip having



Digitized by Google

figures 0 to 9 as shown in **8**, **9**, and **10**. The levers are in their right position when the required numbers are visible at each window.

**11** shows the normal position of apparatus, *i. e.* ready to receive a call. The levers as shown are set with their earthed springs on




**11.**—ORDINARY SUBSCRIBER'S TELEPHONE CIRCUIT.

contact pins 1, 7, 4 and 6 respectively. When the crank handle is turned the brush arm is mechanically shifted so that its brush rests upon contact "*E*." The arm "*c*" is lifted out of the notch and rides on the ridge of the disc, consequently the arm extension "*d*" presses spring "*a*" into contact with "*b*." The turning of the crank handle also winds up a spring which tends to rotate the toothed wheel carrying the disc and brush arm in the direction



Digitized by Google

shown by the arrow. **29** is the theoretical circuit when a call has been "turned in," and will be dealt with more fully in Part 3. Impulses from the Exchange signal controller switch pass over line 2, *viâ* "*b*," "*a*," through the signal or stepping magnet, as in **11**. The movement of the armature and the corresponding operation of the double-toothed pawl allows the toothed disc to rotate under the tension of the spring, and the brush which is connected to line 1 is carried over the points. At the Exchange end of line 1 is a relay which is operated immediately the brush touches an earthed contact. As will be shown later, during the interval between the time of touching the first contact of each quadrant and the time when the earthed contacts are reached, three register magnets at the Exchange record the number of lever contacts passed over, and register the numbers set up in the thousands, hundreds and tens quadrants respectively. The impulses over line 2 during the passage of the brush over the fourth or units quadrant cause the operation of the wipers of the final switch to move and pick up the called line.

After a complete rotation the arm "*c*" falls into the notch again, as shown in **11**, springs "*a*," "*b*" are disconnected, and the subscribers' telephone circuit is joined across lines 1 and 2 *viâ* the brush.

The subscriber's speaking circuit consists of a combination of two non-inductive resistances and two bridging coils, with the receiver in bridge. This is the Canadian Co.'s circuit, but is in no way essential to the automatic system, as any C.B. speaking circuit can be applied. The mechanical details will more clearly appear when considering the party line telephone set in **12**. The mechanism is similar, with the exception that in the ordinary set, items 296, 297, 298, 291, 293, 294, and arm 285 are omitted.

*Party line set, with interlocking arrangements* (**12**).—When a party line station has engaged the line there is a potential difference between the "A" and "B" lines as in **34**.

If a second station attempts to set up a call the mechanism is so arranged that on turning his crank handle he will find that it will not move round an arc greater than 90°, but will spring back when the crank is let go, so that he cannot originate a call nor interfere with the connection.

The interlocking details are shown in **12**.

The ends of spring 282 are attached to pins 281 and 283; the former is fixed to the reverse side of the toothed disc 239, and the latter pin is fixed to the spur gear 286, which is sleeved upon shaft 280. 286 therefore turns independently of 239 and 242 which are keyed together.

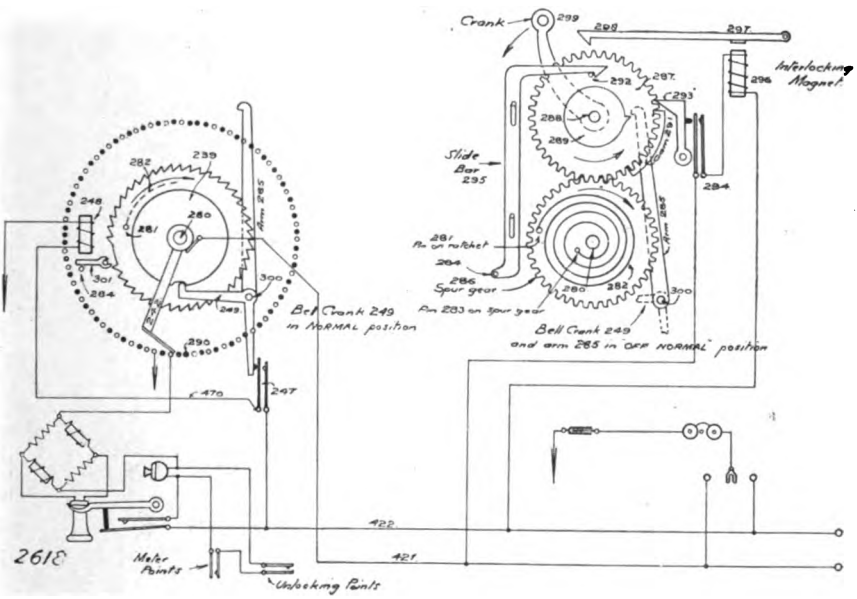
In its normal position the tooth of 249 rests in the slot of 239 and its arm 285 is clear of the tooth of cam 289. At the normal



Digitized by Google

position, therefore, the crank 299 can be turned to cause the rotation of 289 and 287 which meshes with 286. 286 will rotate and carry with it pin 283, consequently spring 282 is put in tension. Cam 291 is attached to the side of 287 and does not interfere with the meshing of the two spur gears. The pawl 293 has a wide tooth and is therefore engaged by cam 291 during its movement.

Assuming the line is engaged, when crank 299 is moved downwards 291 rises and moves 293, springs 294 are pressed into contact and close the circuit of magnet 296, which is now energised by the Exchange battery current; 297 is operated, and 298 drops into a




LEFT HAND VIEW. RIGHT HAND VIEW.

**12.**—PARTY LINE TELEPHONE.

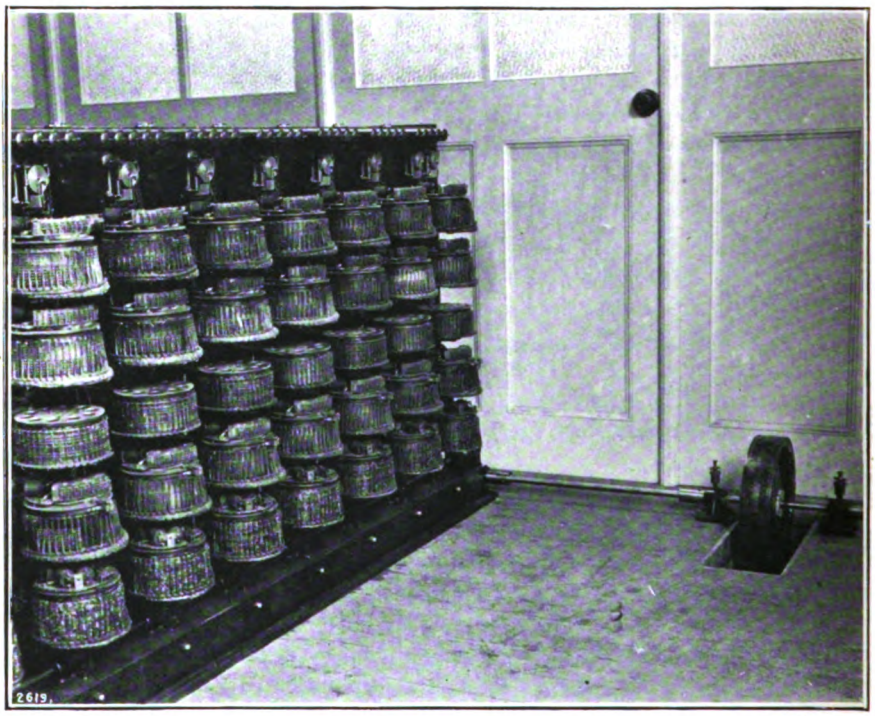
notch and locks 287, thus preventing any further rotation of the crank to set up a call. On releasing the crank, spring 282 causes the restoration of 286, 287 and 299, which snap back. If the line is clear, 296 will not be energised and crank 299 can be turned to make one complete revolution. Towards the end of the revolution of 287, pin 292 is brought against the inclined cam face of the slide bar, which is free to move vertically upwards the length of its slots. 295 is therefore lifted and with it pin 284, which in turn momentarily lifts the arm of the double-toothed pawl 301, removing the detent and allowing the spring to turn 239. At the same moment another pin, not shown in the drawing, engages with 249 and lifts its tooth out of the slot, and brush 242 moves forward with 239 to the earthed contact.



Digitized by Google

With the movement of 249 the tooth of 285 moves into the position shown in the right-hand drawing and engages with the tooth of 289, thus locking the crank until the signalling impulses from the exchange have operated the stepping magnet 248 the necessary number of times to allow the complete rotation of 239 and 242, the bell-crank 249 then drops its tooth into the notch and 285 is brought once more into a vertical position.

*The lay-outof the switchboard* is indicated in **4**. The weight of



**13.**—Main Shaft and Drive Wheel.

each 100-line unit is 2800 lbs., and its overall dimensions, with all apparatus fitted, are—length, 9 ft.; width, 1 ft. 7 in.; height, 4 ft. 4 in.

*Elevation and general views* are given in **1**, **2** and **3**. The drive motors are of one horse-power each. One motor is sufficient to drive twelve switchboards, each having seven connective divisions. The power is transmitted by belt to the main shaft, which is carried at right angles to each switching unit, as in **13**, and by means of gearing keeps in continuous rotation, at a uniform speed, the horizontal main shaft of each switchboard, which in turn is geared to eight vertical shafts, as in **2**.

Clutches are provided to release any defective part from the



Digitized by Google

driving shaft, thus preventing accident to one part from affecting the operation of the other parts.

The moving parts of the switches, viz. the wipers, are driven by machine power transmitted by the vertical shafts, and the distance and times of their movement are under magnetic control by means of a loose gearing, as will be explained.

*The construction of all the cylinder switches,* viz. "A," "B," signal controller, interconnector, pilot and division starter, is similar, and they can be made from the same metal mould.

**14.**—No. 6 Pilot Switch swung out.

These cylinder switches are shown diagrammatically in **39** to **47**. External and sectional views are given in **15** to **25**.

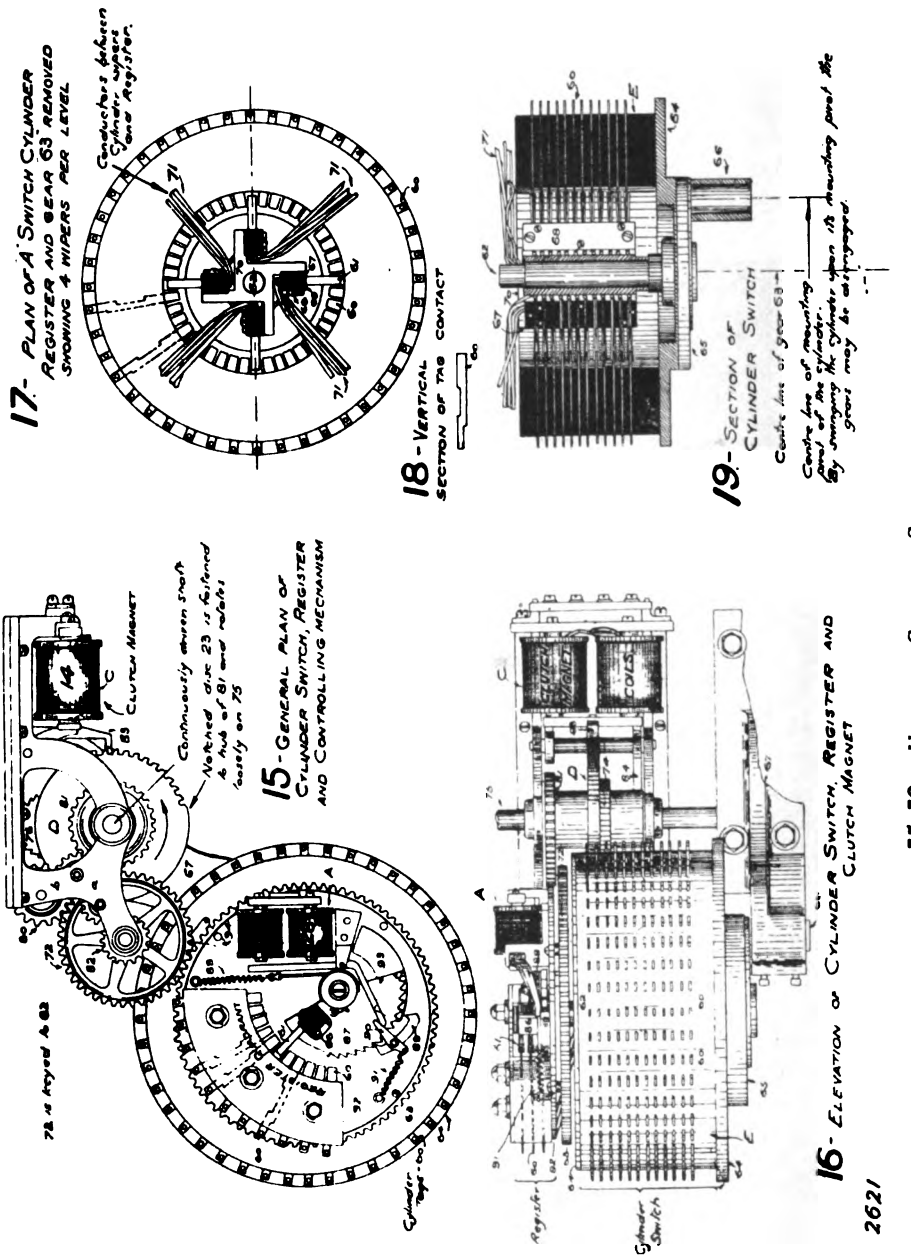
The tags, 60, are first fixed in position in a made-up metal mould. A mixture of plaster of Paris and water is then poured into it, and as the cement solidifies, the tags become embedded in the mixture. The whole is placed in an oven and baked, after which the metal mould is taken to pieces and removed. The plaster of Paris cylinder, with its tags, is then immersed in a mixture of paraffin and Brazilian wax, which is raised to a temperature above that of the boiling-point of water and below that of boiling paraffin; it is then removed and allowed to cool. The Brazilian wax prevents absorption of moisture and counteracts the hygroscopic nature of the paraffin. The cylinder is finally varnished with shellac.

The tags and wipers are of German silver. The wipers, which



Digitized by Google

consist of two flat springs and make contact with both faces of the


17- PLAN OF A SWITCH CYLINDER REGISTER AND GEAR 63 REMOVED SHOWING 4 WIPERS PER LEVEL
18- VERTICAL SECTION OF THE CONTACT
19- SECTION OF CYLINDER SWITCH
15- GENERAL PLAN OF CYLINDER SWITCH, REGISTER AND CONTROLLING MECHANISM
16- ELEVATION OF CYLINDER SWITCH, REGISTER AND CLUTCH MAGNET
2621

15-19.—Views of Cylinder Switches.

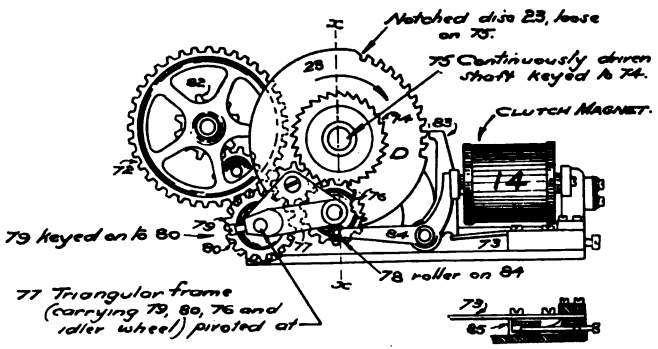
tag contacts, are fitted in a cast-iron spider and insulated by means of india-rubber.

The speed of the cylinder wipers is twenty-four revolutions per

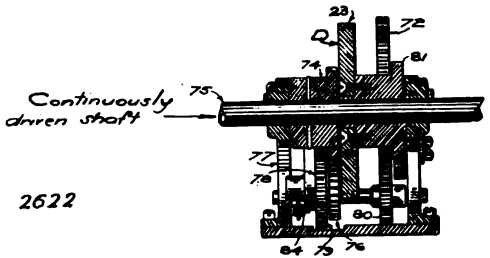


Digitized by Google

20. PLAN OF CLUTCH, VIEW FROM BENEATH.


Notched disc 23, loose on 75.
75 Continuously driven shaft keyed to 74.
CLUTCH MAGNET.
79 keyed on to 80
77 Triangular frame (carrying 79, 80, 76 and idler wheel) pivoted at
78 roller on 84

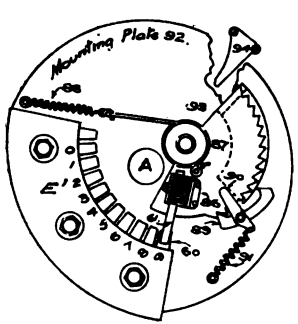
21



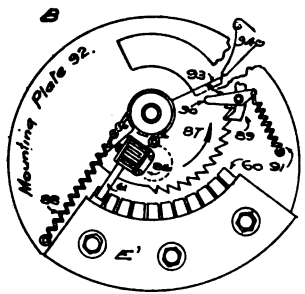

22. SECTION x-x

PLAN VIEWS OF REGISTER

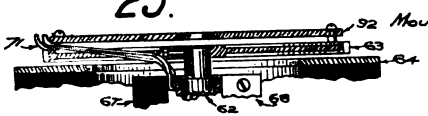
23.

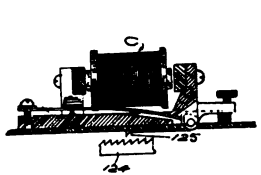


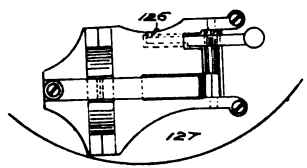

24.




25.





20–25.—VIEWS OF CYLINDER SWITCHES.



Digitized by Google

minute with the exception of those of the " B " switch, which make twelve revolutions per minute. The necessity for this will be seen when discussing the signalling operations.

**15** is a general plan of the cylinder switch register and controlling magnet and mechanism ; **16** an elevation of the same ; **17** sectional plan with register removed and upper wipers and tags of line-finder revealed ; **19** section of cylinder switch ; **20** plan of the clutch, looking from beneath ; **23** and **24** plan views of the register, illustrating the manner in which it is restored to zero.

An examination of the above drawings reveals the following: When the clutch magnet 14 is energised, 83 is pulled out of its notch into the position shown in **20** ; the armature elbow 84 presses its roller against the pivoted frame 77 and causes 76 to engage with the continuously rotating toothed disc 74. The motion is therefore communicated by 76, 78, idler wheel, 79 and 80 to 72. 72 and 82 rotate. 72 is geared to 63, which is pinned to the spider 70, shown in **17** and **19**. The wipers move accordingly.

82 is geared through idler wheels *a* and *b* with 81 rigidly fixed to the notched disc 23 as in **15**. This combined wheel and disc is loose on the main vertical shaft and rotates in the direction indicated by the arrow so long as the clutch magnet remains energised.

It should be noted that 63 also carries plate 92 on which the register mechanism is mounted. The register moves as a whole with 63, the relative positions of its wipers and contacts are unaffected at this stage. The chamfered edges of the teeth of disc 23 assist 83 in rising clear of the notch should the impulse through the clutch magnet be brief, and so long as 83 rides on the ridge of 23, the rotation of 63 and 23 must continue. Thus the stop positions of the wipers and the number of contact points passed over depend upon the positions of the notches in 23 ; these positions are varied with each switch as will be seen by comparing the notched discs in **28** and **39** to **47**.

The adjustable antagonistic spring 73, shown in **20** and **21**, causes the restoration of 83 to its normal position immediately a notch comes within range after the clutch magnet is de-energised.

*Plan views of the register* are given in **23**, **24** and **15**, and these, when considered together, explain the actions of the register, which is mounted on 92. **24** shows the wipers in their normal position with the spring 88 in tension. This spring has a flexible strap which passes round *B* and is fixed to a pin in the sector 87 close to 86. When an impulse passes through the register magnet 28 the armature extension strikes the arm 90 of the scape lever 89. Escapement sector 87 therefore shifts its position in the direction of the arrow in **24**, and moves the wiper 61 to the next contact point.

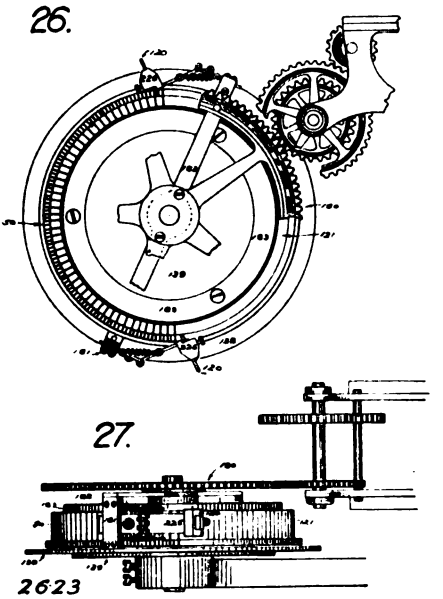
After five such impulses the wipers will be in the position as



Digitized by Google

shown in **15**. Ten impulses cause the brush to assume the position shown in **23**, and this is as far as the wipers may move, being stopped at that point by mechanical means.

To understand how the combination is brought into its normal position as in **24** it is necessary to explain that *A* in **23** is the pivotal centre of the plate 92 which carries the sector, and that the pivotal centre *B* of the sector itself is eccentric to *A*, consequently when the release of the cylinder switch takes place the plate 92 moves round with it, and if the wipers are off their normal position, 93 will be at such an angle that it strikes against 94 rigidly fixed to




**26** AND **27**.—DECIMAL CONTROLLER.

the permanent framework. The toothed sector 87 with its wipers therefore remains stationary, whilst the register contact frame *E* rotates with 92 and its contacts move past the wipers. When *E* reaches the position as shown in **24**, the normal tags have been brought into contact with the wipers, the eccentric action has shifted 93 clear of 94, spring 88 has been put once more in tension, and the scape lever and pallet 89 and 90 have been carried along with mounting plate 92 to the end of 87.

The combined cylinder and register switch can be swung out as indicated in **19** and **14**.

*The decimal controller* shown diagrammatically in **28** as a bar, half of which is split up into small segments, is actually a commutator ring, and the brushes are placed at opposite points on its diameter,



Digitized by Google

as shown in **26** and **27**. Its action is very simple. When the clutch-magnet is energised, the toothed wheel 180 rotates and carries the two brushes with it around the commutator. The solid half is the collector segment, to which the brushes connect the small segments in succession.

* * *

### 3. Circuit Details.

The Lorimer system is essentially a wiring scheme, and to appreciate it aright a serious study of the circuit diagrams must be made.

It is believed there are not a few readers of this JOURNAL to whom a complicated wiring diagram is not only an intellectual treat, but a thing of beauty and a positive joy. To such the inclusion of plates **39** to **47** in this article will, therefore, afford a few delightful half hours in unravelling and straightening out the mesh of lines. Such a task when completed will reveal to the student the complete nervous system of the creature under dissection.

Simple diagrams are also included to make the first steps easier. The numbering of the wires is arranged to facilitate tracing, each having index letters: *A* denotes wires connected to the *A* switch; *B* to *B* switch; *C* to signal controller; *P* to pilot-switch, etc.

We will assume that Subscriber No. 1714 has set up a call for No. 1746. The first operation of the mechanical operator is:

#### TO FIND THE CALLING LINE (**28**).

For this purpose the line relay, sequence relay, division starter, decimal controller, pilot switch and line-finder switch are brought into use.

It is required to extend lines *AL* 1, *AL* 2, *AL* 3 to the pilot-switch, the *medulla oblongata* of the mechanical operator's brain. To do this it is necessary to shift the three wipers marked "*B*" to points "*A*," wipers "*D*" to points "*C*," and wipers "*E*," to the teed-collecting segments "*F*."

When the call is set up and the crank turned, the line relay is operated with the following results:

(*a*) Units signal identifying wire *A* 4, *L* 34 earthed at line relay.

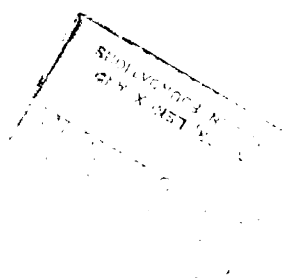
(*b*) Decimal controller tens signal identifying wire *L* 11, D 1 also earthed at line relay.

(*c*) Sequence relay *O* 4 energised, and division starter clutch magnet circuit closed *viâ E* 28, *L* 28, and *L* 27.

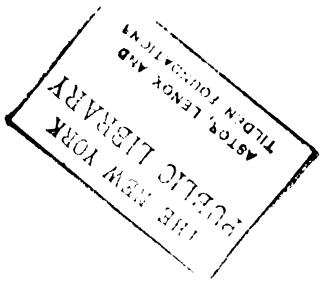
The division starter wipers move to position *I*, the next stop position. If the first pilot switch is already engaged the division



Digitized by Google



Digitized by Google




Digitized by Google

starter clutch circuit will be closed *viâ* *E* 11 and P 28; the division starter wipers will, therefore, move forward to the next wait position, where the clutch magnet still finds earth over *E* 28, consequently the wipers are moved forward to position 2, and so on, until an idle pilot is found. Assuming, however, that No. 1 is idle, the pilot clutch magnet circuit will be closed *viâ* *J* 2, *M* 11, *E* 1, 3 × 6 — 3 × 5 to earth.

To facilitate tracing the circuit connections, the contact points are denoted by their number and level; thus 3 × 6 — 3 × 5 means contact 3 of level 6 and across the bridged wipers to contact 3 of level 5.

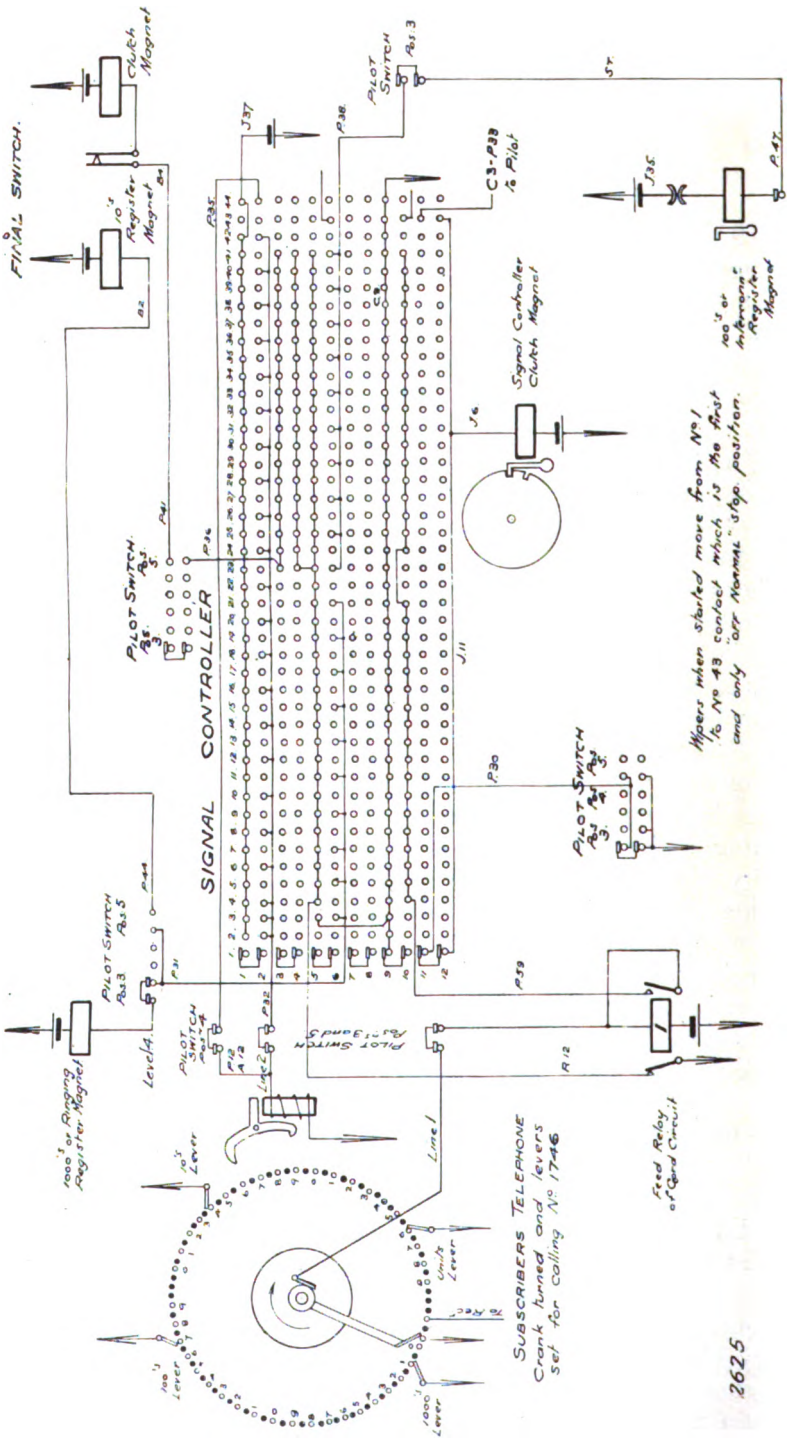
The pilot clutch magnet is energised, its wipers shift to position 2 closing the circuit of the line finder clutch magnet *viâ* *P* 86, 3 × 11 — 3 × 10, *P* 2 to earth, and the line finder cylinder wipers are started and will continue to move until the feed relay is energised. The decimal controller clutch circuit is also closed *viâ* *D* 18, *K* 28, *P* 23, 3 × 12 — 3 × 13, *P* 2, *R* 2, and feed relay contact. Thus, the wipers of both the line finder and decimal controller switches move simultaneously but independently.

The top wiper *H* of the second quadrant of the line finder switch successively taps *A* 0, *A* 1, *A* 2, *A* 3, and *A* 4. At the last-named point it finds earth at the line relay over *A* 4. This earth is thus connected *viâ* the bridged wipers *H.J.* of the second and fourth quadrants to *A* 15, *P* 15, bridged wipers in second position of the second level of the pilot switch, and so to *P* 1, *R* 1, and feed relay No. 1 which energises and breaks the earth away from *R* 2, P 2. The line finder clutch magnet therefore de-energises, and the cylinder wipers of each of its quadrants remain on the sixth contact counting from their normal positions. Lines *AL* 1, 2, and 3 are therefore connected through *B* to the three No. 1 contacts *C* at the tens register.

It should be noted that although the decimal clutch circuit is also cut away from earth at the feed relay contact, the wipers on the decimal controller continue to move until they reach the stop position "*S*." During their movement the decimal relay which is connected to the long segment, taps each tens identifying wire and also the ten teed connections of *D* 11. When the forward brush makes contact with the segment marked 1, which is earthed at the line relay, the decimal relay is energised *viâ* *D* 13, bridged brushes and 1 and locks itself *viâ* its own armature. The decimal controller brushes are now earthed *viâ* *D* 13 and the decimal relay armature, consequently as they continue to pass forward *D* 11 is earthed twice. The tens register magnet circuit is closed twice *viâ* battery, first quadrant wiper *G*, register magnet, third quadrant *K*, *A* 19, pilot switch 3 × 1—4 × 1, *P* 29, *D* 11 decimal controller brushes, *D* 13



Digitized by Google


FINAL SWITCH.
Clutch Magnet
10's Register Magnet
PILOT SWITCH
SIGNAL CONTROLLER
Signal Controller Clutch Magnet
100's or Intercept Register Magnet
Wipers when started move from No 1 to No 49 contact which is the first and only "off Normal" stop position.
PILOT SWITCH
1000's or Ringing Register Magnet
Level
Line 1
Feed Relay & Cord Circuit
SUBSCRIBERS TELEPHONE Crank tuned and levers set for calling No 1746
2625

29.—Signalling Circuit Arrangements.



Digitized by Google

and relay contact, earth. The register magnet, therefore, shifts its wipers *D* two positions to the right, *i.e.* to the No. 1 contacts at *C*, which are connected to the cylinder wipers *B* on the level of the calling line terminals *A*. The calling subscriber's lines and guard wire are now through to the pilot switch No. 6 contacts on the first, second, and third levels *viâ A*, *B*, *C*, *D*, *E*, and *F*.

When the decimal controller brush reaches its stop position "S" the earth contact on the decimal relay *viâ D* 13 is connected to *S*, *D* 10, *M* 12, pilot switch 3 × 14 — 4 × 14, *J* 2. The pilot clutch magnet energises and shifts all its wipers to position 3 and causes the following operations. Battery is applied to the C.O. relay *viâ* 100ω coil, *P* 88, third level wipers of pilot switch 5 × 3 — 6 × 3, *DL* 3, *CL* 3, *BL* 3, *AL* 3. The C.O. relay is energised, but not the meter, which is adjusted to operate at 30 volts and to be inoperative at 16 volts. The lines are cut away from the Exchange relays, the circuit is guarded against interruption and the line and sequence relays de-energise.

The division starter is moved from its position 1 to its next wait position by the starter clutch finding a circuit across its fourth and third level wipers which are at position 1, E 11, P 28, pilot switch seventh level contact 5 and wipers to earth. The movement of the division starter wipers to their second wait position causes the decimal clutch magnet to energise, its circuit being closed *viâ D* 18, *E* 18, starter wipers at wait, E 10, *S*, decimal controller brushes, *D* 13 and armature earth. The decimal controller is therefore restored to its normal condition with its brushes on the long bar and *N* respectively, as shown in **46** and the decimal relay de-energises.

The decimal controller and division starter are now ready to attend to another call, the former being at normal, the latter with its wipers on the second wait position.

Total time occupied in finding calling line and joining through to pilot switch is 1¼ seconds.

## Signalling and Registration of Numbers

set up by calling subscriber.

**29** is an explanatory diagram showing the operation of the subscriber's signalling apparatus by the Exchange signal controller, and the registration of the thousands, hundreds and tens numbers set up by the caller.

The pilot switch in position 3 closes the signal controller clutch magnet circuit *viâ J* 6, *J* 11, 1 × 12 — 1 × 11, *P* 30 and earth.

The wipers are started and continue to move until they reach their first stop position at contact 43. During their progress the thousands and hundreds registers record the numbers set up by the



Digitized by Google

corresponding levers at the subscriber's telephone. To determine the tens and units numbers, the signal controller wipers perform a second rotation as will be explained.

### The Registration of the Thousands Digit,

which determines the ringing signal, takes place as the wipers move from normal to contacts 22.

It will be seen that the ringing register is connected *viâ* level 4 of the pilot switch in position 3 to ten contacts having odd numbers 3 to 21 on level 6 of the signal controller, therefore as the bridged wipers of levels 5 and 6 pass over these points they will close the register magnet circuit *viâ* C 9, R 12 ten times if relay 1 is not energised. Line 2 is connected to contact 3 and also to the contacts having even numbers 2 to 42 on level 2. When the signal controller wipers are on contact 2, battery is applied *viâ J* 37, levels 1 and 2 to *P* 32, line 2. The subscriber's signal or stepping magnet is energised, its brush moves off the earthed contact to 0, and remains there until the controller wipers leave contact 4.

With the wipers on contacts 3, the thousands register magnet circuit is closed *viâ P* 31, 3 × 6 — 3 × 5 and *C* 9. The register wipers shift to their ringing contact sets No. 1.

On contacts 4 the register magnet circuit is broken.

On contacts 5 the subscriber's stepping-magnet de-energises and the brush moves to the intermediate dead contact between 0 and 1. The ringing register magnet circuit is again closed this time *viâ P* 31 and *R* 12 and its wipers shifted to ringing contact sets No. 2.

On contacts 6 the stepping magnet is energised, the subscriber's brush moves to 1 and finds earth thereat. Relay 1 now energises and locks itself *viâ P* 59, levels 10 and 9 to *C* 9 and earth, thus cutting out the register magnet from further action. Impulses continue to be sent over line 2 operating the stepping magnet, and the subscriber's brush passes over the remaining contacts of its thousands quadrant.

When the signal controller wipers reach contacts 22, relay 1 is unlocked and contacts 4 to 41 on level 5 are earthed again *viâ R* 12.

### Registration of Hundreds Digit (29).

On contacts 23 the inter-connector or hundreds register magnet circuit is closed *viâ J* 35, *P* 47 pilot switch *P* 38, levels 6 and 5 to *R* 12 and earth, and its wipers are moved to their first tens position.

On contacts 24 battery is applied *viâ J* 37, *P* 32 to line 2 and the stepping magnet operates. The interconnector register circuit is broken.



Digitized by Google

As the signal controller wipers continue to pass forward over the contacts, impulses are sent alternately over line 2 and the register magnet circuit. Immediately the subscriber's brush reaches contact 7 relay 1 operates and breaks earth away from level 5 and cuts out the hundreds register from further operation, leaving its wipers on the 700 group.

The signal controller wipers stop on contacts 43 until the interconnector switch has found a disengaged trunk in the 700 group.

### Interconnector Search for Idle Trunk to the 700 Final Switch Group (30).

By referring to **43** it will be seen that there are 4 wires per trunk circuit between the final and interconnector switches. Where these switches are in different exchanges repeating relays are introduced to provide for signalling over the two line wires.

In the explanatory diagram **30** the two speaking wires are omitted for the sake of clearness.

Relay 3 operates immediately the pilot switch reaches position 3, its circuit being closed *viâ* level 9, *P* 75, *P* 41, *S* 1, *B* and *C*. The signal controller wipers, as already explained, are stopped on contact 43 and the circuit conditions are as shown in **30**. The interconnector clutch magnet circuit is closed *viâ* *P* 43, pilot switch level 5, relay 3 armature, *R* 14 to earth. The magnet operates and breaks the pilot clutch magnet circuit at *S* 5 and *S* 6. It also moves its wipers from their normal position to the first contacts, consequently wiper *C* no longer finds earth and relay 3 will de-energise unless brush *A* closes the 12-volt circuit *viâ* *B* 0, *J* 14, *B* 4, *S* 14, *A*, *B*, *S* 1, *P* 41, relay 3, *R* 25, *P* 75, to battery tap. In such a case the current will operate relay 3, but not the final switch clutch magnet.

The condition shown in the diagram is one in which the first final switch in the 700 group is already engaged; therefore, when A reaches 1, relay 3 remains energised and the interconnector clutch is still help up. Wipers *A*, *B*, *C*, *D* and *F* now pass on to the contacts 2. Assuming the second circuit to be clear as shown, and disconnected at *B* 4, then when *A* contacts with 2, relay 3 de-energises, its armature falls back, breaks the interconnector clutch magnet circuit, and all the cylinder wipers stop on contacts 2. *S* 5 and *S* 6 now close the pilot clutch magnet circuit and also the final switch register magnet circuit of the second trunk *viâ* *J* 33, 2, D, *F*, *S* 2, *P* 42, *S* 6, *S* 5, *R* 15, *R* 14 to earth. No. 2 final switch register magnet shifts its wipers to their off normal position, and this action mechanically closes its own clutch magnet contacts *J* 14, *B* 4, making it busy at the other interconnector taps.



Digitized by Google

The pilot switch moves to position 4, and in so doing closes the clutch magnet circuit of the signal controller, whose wipers now move to normal as shown in **29**.

As the top pair of wipers pass over the 44th contact they close the battery circuit *viâ* *J* 37, *P* 35, position 4 of pilot switch, *P* 12, *A* 12 and line 2, operating the stepping relay and causing the telephone brush to pass over the dead contacts between the hundreds and tens quadrants.

The restoration of the signal controller in turn causes the pilot switch to move to position 5.

### Registration of Tens Digit (29).

With the pilot switch wipers in position 5, the tens register magnet circuit of the final switch is connected *viâ* *B* 2, *P* 44, *P* 31 to the contacts on level 6. The ringing and interconnector register are no longer in circuit.

The registration of the tens digit is similar to that already described for the thousands digit. As the signal controller wipers pass over contacts 2 to 22, the tens register wipers are shifted to the No. 40 set.

### Operation of Final or "B" Switch Wipers to find called Line (29).

Signal controller contacts 23 to 42 of levels 3 and 4 are teed together and the final connector clutch magnet circuit will be closed *viâ* *B* 4, *P* 41, *P* 36 and *R* 12 as the wipers pass over contacts 23 to 42, so long as relay 1 remains de-energised.

Impulses are sent *viâ* *J* 37, levels 1 and 2, *P* 32 and over line 2. The subscriber's brush passes over the contacts of the units quadrant, and when No. 6 is reached, relay 1 operates and the final connector clutch circuit is broken and its cylinder brushes remain on the No. 6 contacts of each group.

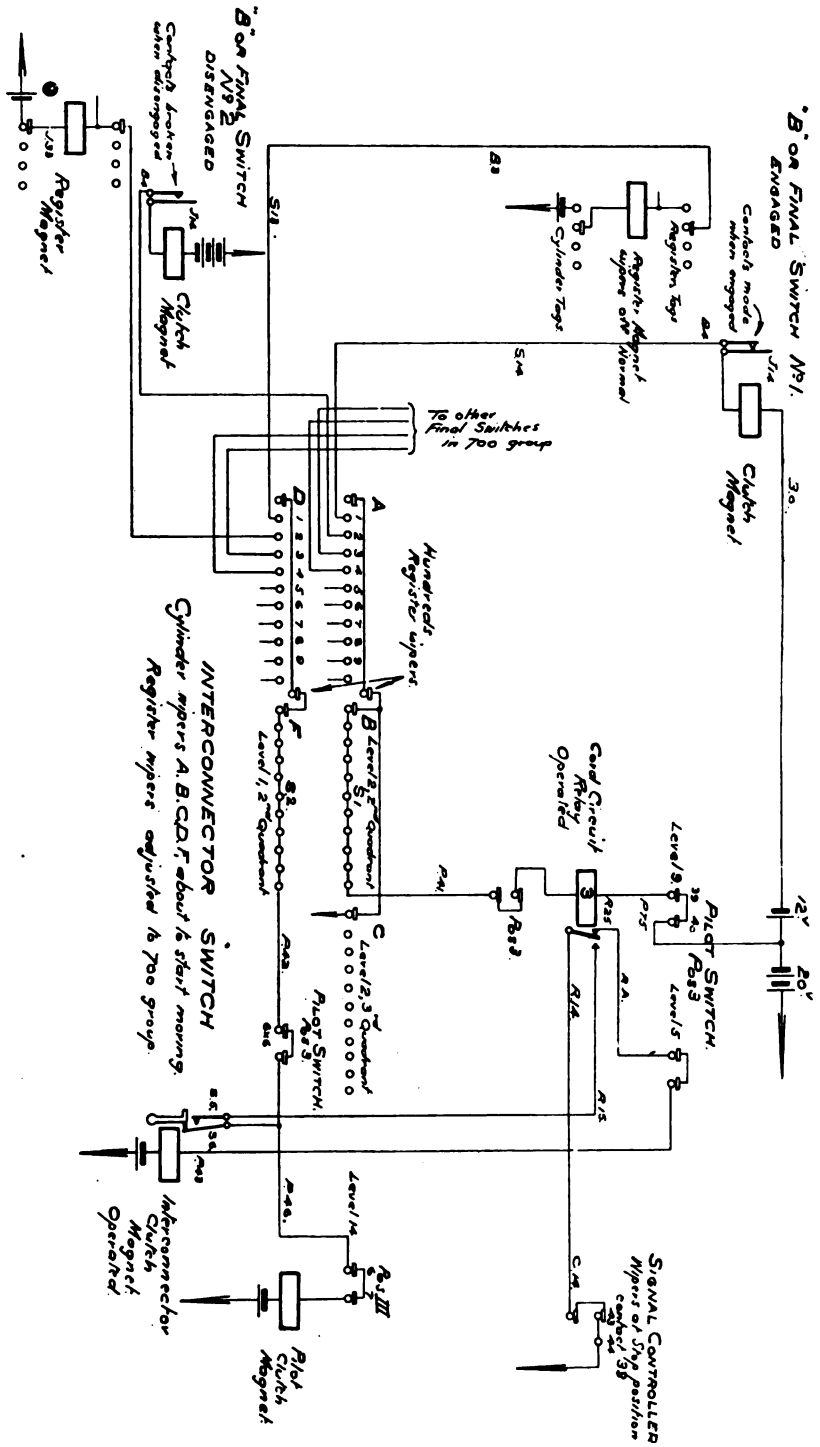
By referring to **44** and **29**, it will be seen that the final connector cylinder wipers have to pass over six contacts to reach No. 6 of the 40 group, whereas the signal controller wipers pass over twice that number of contacts in the same time, consequently the final connector is geared to rotate at half the speed of the signal controller. The operation of the final connector wipers is caused by one impulse of a certain length, determined by the time interval between the first make contact of the signal controller wipers with points 23 and the operation of relay 1.

### Busy Test.

The signal controller wipers stop on contacts 43 as in **31** and close the pilot clutch magnet circuit *viâ* *J* 2, contacts 11 and 10



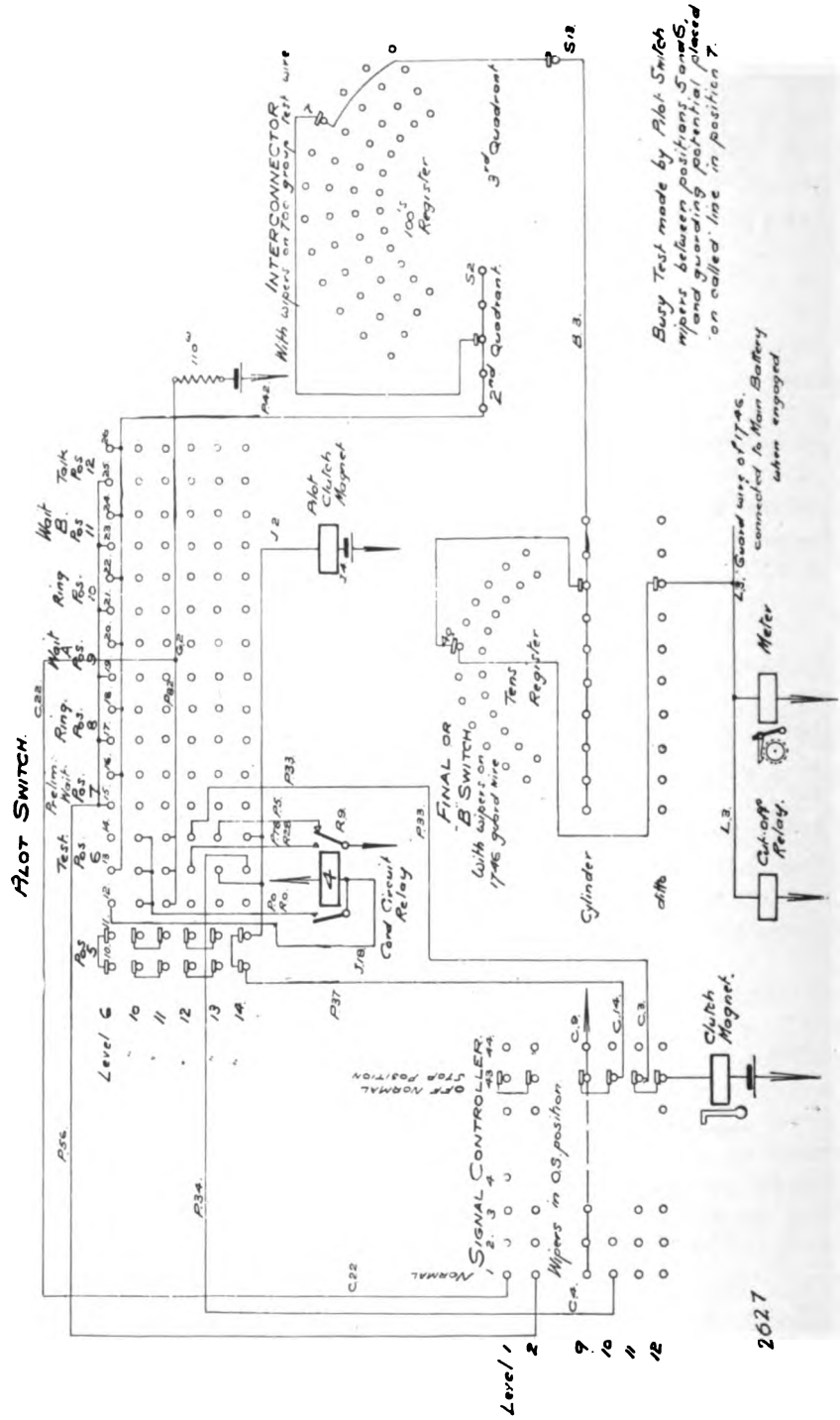
Digitized by Google




30.—Interconnector Search for a Disengaged "B" Switch.



Digitized by Google




31.—Busy Test and Guard Circuit.



Digitized by Google

of level 14, *P* 37 and *C* 14 to *C* 9. The pilot wipers are shifted from position 5 to 6, and in passing over the intermediate contacts 12 test the guard wire *L* 3 and the result is recorded by relay 4. If No. 1746 is busy, there will be a negative potential on the guard wire and current will flow *viâ* *L* 3, cylinder collective segments of final switch, *B* 3, *S* 13, 7, *S* 2, *P* 42, 13 × 6 — 12 × 6 to relay 4 which operates and is locked *viâ* 110$^{\omega}$, *G* 2, *P* 82, contacts 12 of levels 11 and 10, *P.O.*, *R.O.*, and left armature to 4.

As the pilot wipers reach position 6 the pilot clutch magnet is energised again *viâ* *J* 2, 13 × 13 — 13 × 12, *P* 78, *R* 9. Its wipers shift to position 7, whence by the same process as if the line were found idle, the wipers are further advanced to position 10, and the busy tone is applied to the calling line from levels 11 and 10 of the pilot switch, through the signal controller contacts 43. This circuit can be traced through on **40, 42, 41, 40** and **39**, as follows: Busy to pilot points 21 and 22, levels 11 and 10, *P* 84 and *P* 85, signal controller *C* 24 and *C* 25, points 43 of levels 5, 6, 7 and 8 to *G* 6 and *G* 7, condensers, *G* 3 and *G* 1, *P* 3 and *P* 1, pilot levels 1 and 2 to calling lines at *A* switch.

### Guarding Called Line (31).

Assuming No. 1746 to be disengaged, relay 4 will not be operated between positions 5 and 6, the wipers of the pilot switch therefore stop at position 6. This closes the signal controller clutch magnet *viâ* *C* 3, *P* 33, 14 × 12 — 14 × 13, *P* 5 and *R* 9. The signal controller now returns its wipers to their normal position. The pilot clutch magnet is then operated *viâ* *J* 2, 14 × 14 — 13 × 14, *P* 34, 1 × 10 — 1 × 9 to *C* 9 and the pilot wipers move to position 7. Battery is applied to the guard wire of 1746 *viâ* 110$^{\omega}$, *G* 2, *C* 22, signal controller 1 × 1 — 1 × 2, *P* 56, 15 × 6 — 16 × 6, *P* 42, *S* 2, *S* 13, *B* 3 and *L* 3. This operates the cut-off relay and guards the called line. The meter is inoperative with the 110$^{\omega}$ in the battery circuit.

The called subscriber's lines are now joined through to the fourth and fifth levels of the pilot switch *viâ* *B* 1, *B* 2, interconnector switch, *P* 44 and *P* 48 as indicated by the thickened lines in **44, 43, 42, 41** and **40**.

The pilot switch stops at position 7 to await the beginning of a code ringing cycle as in **32**.

### Ringing Arrangements.

The ringing commutator rings are shown in **41**. The first nine rings rotate at 20 revolutions per minute, the tenth at 5 r.p.m.,



Digitized by Google

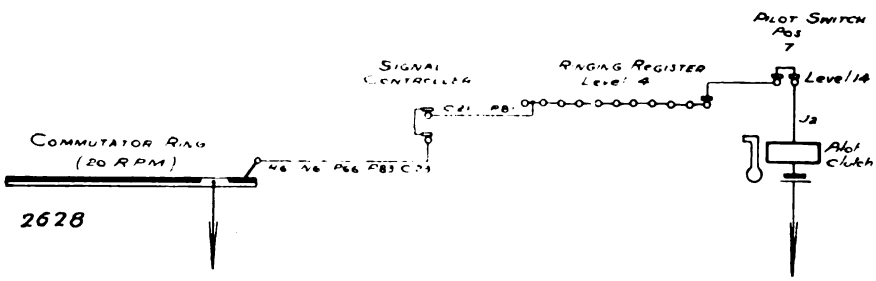
and the ring marked 15 rotates 5 times in 9 minutes and is called the slow drive.

The first five rings cause a series of 1, 2, 3, 4 or 5 earth impulses at 20 per minute. Nos. 6, 7, 8 and 9 send 20 momentary impulses per minute, but at different times. No. 10 applies the main battery to its circuit 5 times per minute. No 15 applies a momentary earth 5 times in 9 minutes. These commutator rings are provided for a system having 10-, 5- and 2-party lines, but as there are no 10-party lines at Hereford, Nos. 8 and 9 are not used.

Where a system of code signalling obtains it is necessary that the first ringing signal should—

(1) Be applied at the commencement of a code cycle to avoid a distorted call, and—

(2) With a minimum of delay after the called line has been found disengaged.




**32.**—Pilot Switch waiting Ringing Cycle.

To provide for (1) the pilot switch wipers are held at the preliminary wait position No. 7 for a fraction of a code-signal interval until the clutch magnet circuit is closed by the No. 6 commutator ring, which keeps time with the code signal commutator rings as in **32**. The wipers then move to the first ringing position, *i.e.* position 8, and battery is applied to the ringing relay 5, energising it. Trace circuit in **34** cord circuit *viâ* *P* 50, *P* 8, *R* 8, 5, *N* 1 and the commutator ring. The generator is thus applied to the called line. After the first ring the pilot switch wipers move to position 9 and there apply battery to the calling line. If the caller has his receiver off the hook, the pilot switch moves to position 10, *i.e.* the second ringing position, and the 5 r.p.m. commutator is joined up. The ringing relay is operated approximately once in every twelve seconds. This slower action is provided by the Canadian Machine Telephone Co. to avoid giving annoyance to subscribers by repeating the rings too frequently, the idea of the inventor being, that having received the first ring the subscriber knows he is wanted, and more



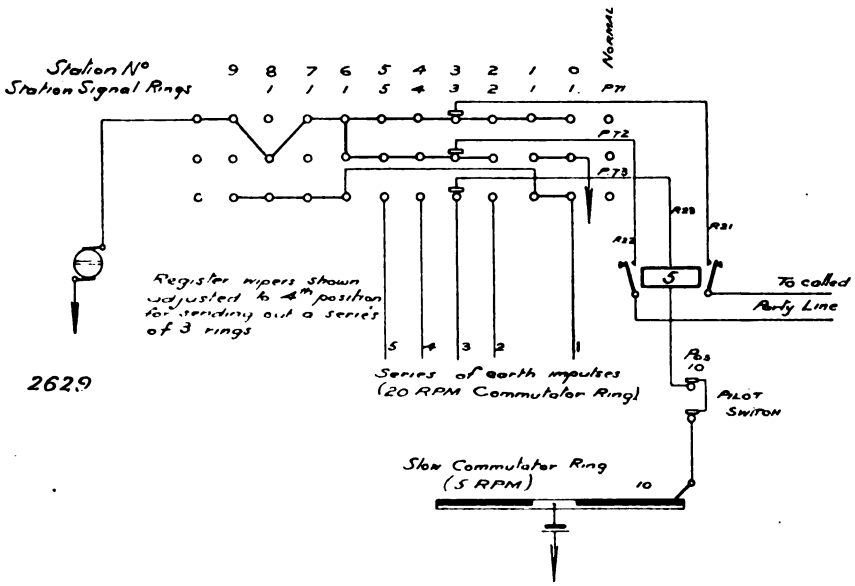
Digitized by Google

frequent ringing does not accelerate his response, and is therefore unnecessary.

If, instead of calling up 1746, the caller had signalled for 3476, then the ringing register will have set its wipers on No. 3 as in **33**, and relay 5 will be energised by a series of 3 impulses and its armatures will apply the earthed generator to both lines and give a series of 3 rings on the bells of the party line circuits, which are joined up for non-selective ringing by code signals.

Arrangements can be made for part selective ringing if desired.

For 2-station party lines the register wipers will be at position 7




**33.**—Ringing Register.

or 8, and the earthed generator is then applied to either line 1 or 2 and selective ringing is obtained.

Time occupied between the turning of subscriber's crank and the first ring is 8 seconds.

### Called Subscriber's Reply (34).

After the first ring with pilot switch in position 8, as already stated, the pilot wipers are advanced to position 9, and the arrangements are such that if the called subscriber lifts his receiver immediately after the first ring, and provided that the calling subscriber has his receiver off, relays 1, 2, 3 and 4 will be energised, *P* 69 and *P* 78 will be earthed, the pilot switch is advanced to position 12, and conversation may then proceed. If the calling subscriber had not removed his receiver when the switch reached position 9,



Digitized by Google

the reply of the called subscriber energises relay 4, places earth on *R* 28 and *P* 78 and shifts the pilot switch to position 11. If the called subscriber gets no response the restoration of his receiver causes the armature of relay 4 to fall back and earth *R* 5. The pilot clutch circuit is therefore closed in this position, *viâ* contacts 23, and also in position 12 *viâ R* 2, its wipers are moved forward to position 13, and the release effected.

Assuming the case where the calling subscriber has duly lifted his receiver and the pilot switch is in position 10, the ringing proceeds until the called subscriber replies; the pilot switch then passes to position 11, relay 3 will be energised, and the main battery will be applied direct to the guard wire of the calling line, the meter operated, and the pilot switch continues moving to the talking position, having passed position 11 without stopping and having operated the meter during its passage.

### Cord Circuit (34).

The cord circuit during conversation is given in **34**. The thickened lines and index letters and numbering correspond to the thickened lines on wiring diagrams **39** to **47**, and will facilitate tracing through.

The Stone system of transmission is employed. The battery voltage is 32.

Relays 2 and 4 are the release relays prior to the talking position, when relay 1 becomes the release relay.

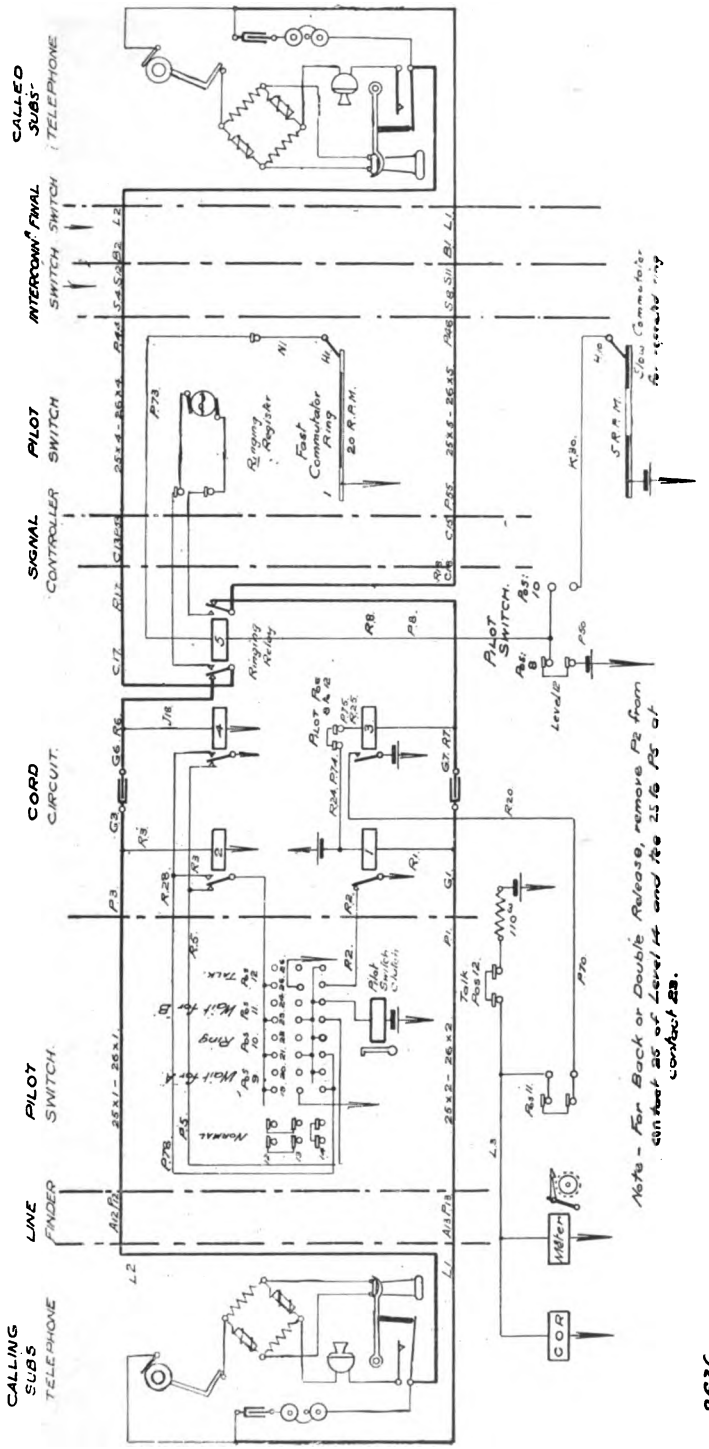
The functions of relays 1, 3 and 4 are not wholly confined to speaking and release. As already explained, relay 1 is used as the test relay in conjunction with the signal controller switch during the registration of the numbers set up at the calling station. It is also used to test the units signal wires at the line finder switch, and when the calling wire is found to break the circuit of the line finder clutch magnet.

Relay 3 is the talking feed relay on the " B " subscriber's side of the cord circuit; the test relay in conjunction with the inter-connector when that switch is searching for an idle junction line, and also directly operates the meter of the calling line when the called subscriber replies. Relay 4 makes the busy test on the selected line in the " B " switch.

The circuit, as shown, is arranged for the standard or single release. When the calling station restores, relay 1 de-energises, *R* 2 is earthed, and the wipers are shifted to position 13, the position of automatic release and restoration. The wipers close the clutch circuits of the line finder and final connector switches. The line finder switch in turn causes the pilot switch to move to positions 14 and 15. The wipers in position 14 close the clutch magnet circuits



Digitized by Google




34.—Cord Circuit with Standard or Single Release Arrangement.



Digitized by Google

of the interconnector and signal controller switches. In position 15 the pilot switch wipers on level 14 close the pilot clutch magnet circuit *viâ J* 4, *J* 2 and *P* 39.

Thus all the switches used in the connection are restored to normal, and each cylinder in its turn picks up its own register sector at its release point, already explained in part 2, and adjusts the register contacts and wipers to their normal position.

The failure of the line finder switch to restore would affect the restoration of the pilot switch, and, as will be explained later, a supervisory and timing device is brought into operation as a safeguard.

In a five-figure system a third release position would be required for the second interconnector switch.

### Back or Double Release.

The connections for the "back release" arrangement, in which the first station restoring effects the release, can be readily given by removing the wire *P* 2 from contact 25 and teeing 25 to *P* 5 at contact 23 level 14.

### Division Starter unable to find Idle Connective Division (47 and 28)

When the seventh connective division has been engaged, the division starter wipers pass forward to their O.S. (out of service) stop position. The clutch magnet circuit is extended *viâ* the clutch magnet, 41 × 4 — 41 × 3, *EO*, *KO*, and also the teed connection of each of the seven divisions to 1 × 12 — 1 × 13 to earth.

If all the pilot switches are off normal, *i. e.* engaged, the division starter clutch magnet circuit is disconnected at 1 × 12. The wipers therefore remain at O.S., but as soon as one pilot switch returns to normal it closes the division starter clutch magnet circuit as above, and the starter returns to its first wait position. If a call has been waiting, the clutch magnet circuit is then again closed *viâ E* 28, *L* 28, etc., and is started searching for the idle pilot switch.

Thus, when a call is waiting and all divisions engaged, the division starter remains at the O.S. position and does not rotate needlessly. An alarm circuit can be arranged for the O.S. position, if desired to know when all the channels are engaged.

### Interconnector unable to find an Idle "B" Switch.

If the interconnector should fail to find an idle "B" switch (43), the wipers pass on beyond the last trunk position, wiper *a* (shown near the register magnet) makes contact with *a* 2 and *a* 3, placing

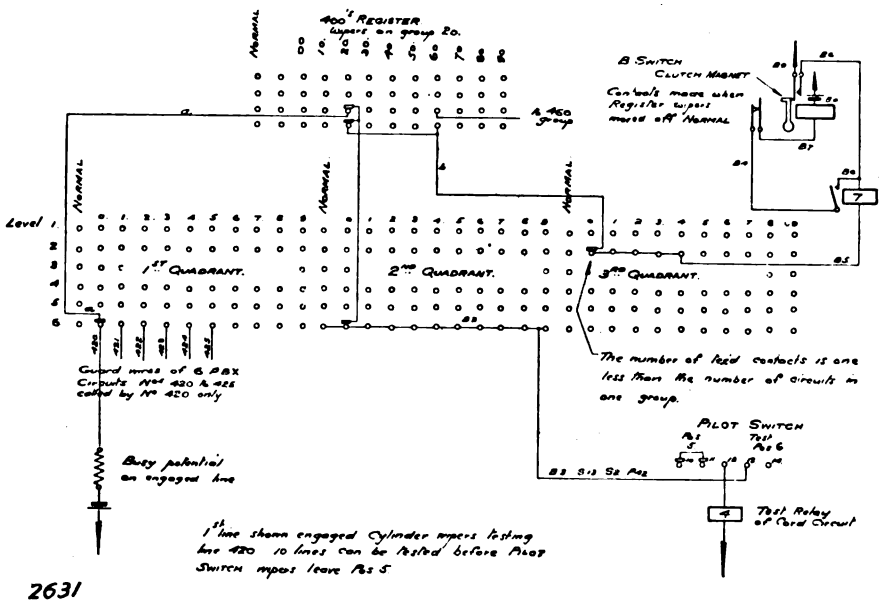


Digitized by Google

earth on *P* 46 connected to 6 × 14 — 7 × 14, *J* 2 and pilot clutch magnet, which operating, shifts its wipers to position 4, and the movements of the signal controller proceed as though a trunk to the 100-group had been found. The subscriber's stepping magnet is operated, the brush cycle is completed, the caller gets no reply, restores and calls again later.

### Pilot Switch Out of Service.

To place a connective division out of service for repairs, etc., the




35.—Rotary "B" Switch for P.B.X. Lines.

wire feeding *P* 39 is removed at the connection rack. The pilot is set off normal by operating the clutch armature or passing a call through in the usual way. The wipers are then automatically brought forward to the O.S. position, at which the supervisory lamps and timing device are cut out.

### Rotary Arrangements for Private Branch Exchange and Duplicate Lines (35).

Where there are two or more lines to one private branch exchange, test desk, or manual board, only the first number of the group is used for signalling purposes. For instance, say there are six lines and the first number is 1420, then this number will be set up for the call and each of the six lines can be searched over to find



Digitized by Google

one which is disengaged. To effect this an additional relay 7 as in **35** is connected to the *B* switch, also a pair of contacts *B* 6 and *B* 9 is fitted to the clutch magnet, and this pair makes contact when the armature is against the magnet core. Additional wiring is also necessary as indicated at *b* and the fourth brush of the register is teed to that on the third level. If the first line is busy, battery will be applied to the guard wire 420 as shown. Consequently, when the register wipers have been adjusted to the 20 group and the cylinder wipers are moved to the first contact, battery will be applied *viâ* 420 guard, *a*, *b*, *B* 5, 7, *B* 6 and *B* 9, before the clutch magnet armature dog can drop into the first notch. Relay 7 is energised and closes the clutch magnet circuit *viâ* *B* 0, *B* 7, *B* 4, *B* 6, and *B* 9. The disc continues to engage with the continuously rotated shaft, and the cylinder wipers continue to move onwards so long as wiper "*a*" finds the battery connected to the guard wire it is testing. If 424 is the first disengaged line, then relay 7 de-energises at that point, the clutch magnet releases its armature and the wipers stop.

It will be seen that the five contacts 0, 1, 2, 3 and 4 of the second level of the third quadrant are teed together, *i.e.* one less than the number of lines in the group. If the first five lines are busy, then the wipers, after leaving 424, must come to rest on 425 as relay 7 circuit is disconnected from "*b*" in that position. If the sixth circuit is engaged the busy test will be made by relay 4 over *B* 3, etc., when the pilot switch wipers pass from position 5 to 6 as already explained, and the busy tone will be applied to the calling line.

Other groups can be located upon the same switchboard unit as shown in **35** by extending wire "*b*" to another tens register contact on the fourth level.

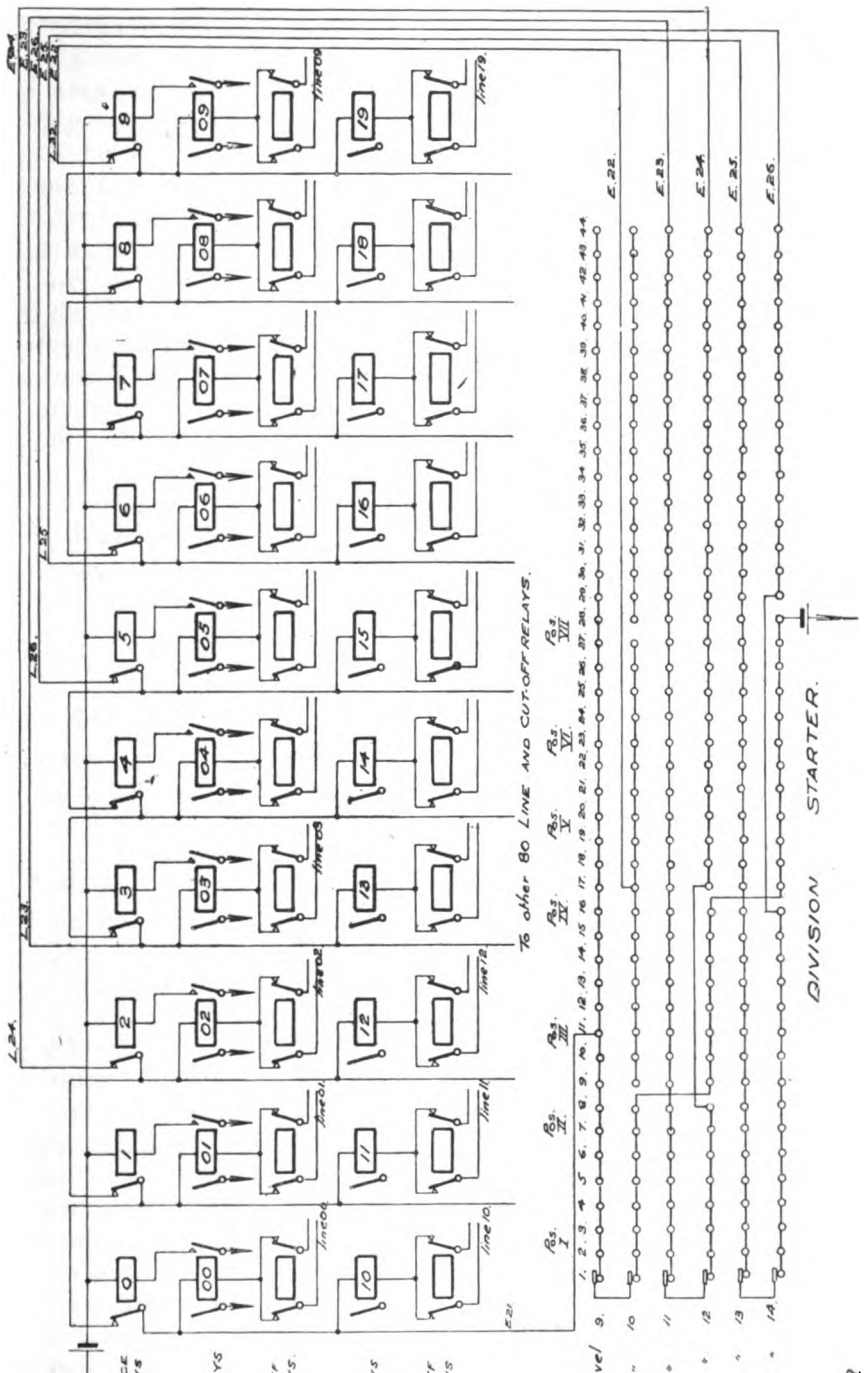
### Simultaneous Calls and Priority of Attention (36).

Calls arriving simultaneously can only receive attention one at a time per 100 group, and some confusion might arise in the line finder switches if several relays having different units were energised simultaneously.

As shown in diagram **36**, with the wipers in positions 1 or 2, the battery circuit is *viâ* levels 14, 12, 10, 9, *E* 21 to the feeding lead of line relays having units digits 0, 1 and 2, thence by *L* 24, *E* 24, levels 12 and 11, *E* 23, *L* 23 to feeding lead of line relays with units digits 3, 4 and 5 to *L* 26, *E* 26 levels 14, 13, *E* 25, *L* 25 to feeding lead of line relays 6, 7, 8 and 9. Priority is therefore given to that line which has the lowest units digit because the left-hand relay will break the battery feed from all those to its right.



Digitized by Google




**36.**—Priority of Calls.



Digitized by Google

This precedence, however, is varied according to the position of the division starter, and the order of priority changed, otherwise it would always operate against the higher numbers.

When the division starter is at position 3 or 4 the sequence is changed, and it will be seen by tracing the circuit from battery to 9 × 12 — 9 × 11, *E* 23, *L* 23, etc., that the order of priority is 3, 4, 5, 6, 7, 8, 9, 0, 1 and 2.

When at position 5, 6 or 7 the order is 6, 7, 8, 9, 0, 1, 2, 3, 4 and 5.

When two lines having the same units digit call simultaneously, the line finder switch adjusts itself to the units position in the usual way, as the units signalling wire is common to both. The brushes of the decimal controller, however, reach the higher tens number first, the decimal relay is operated and signals are sent causing the line finder to adjust its wipers to that line.

If, however, the higher number called a fraction of a second later than the lower number, and the decimal controller brushes had started from normal in response to the call of the lower number, then it will depend upon the exact position of the brushes at the time as to whether the higher number obtained priority or not.

### Rotational Selection of Trunks and Connective Switches.

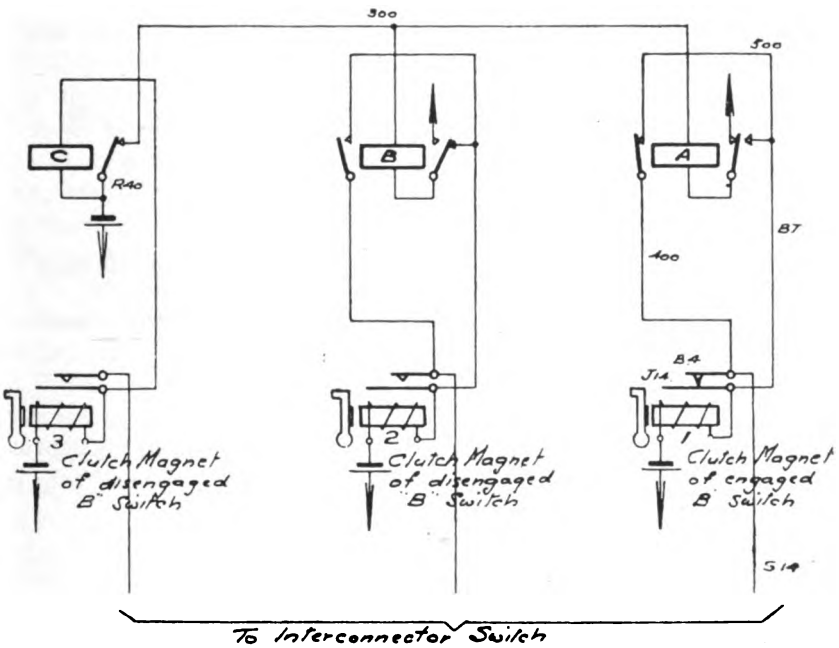
In any automatic system where a selective switch has to search over a level to find a disengaged selector or connector circuit, and where in the case of a series of calls from one subscriber he is practically given the use of the same selector or connector for each call, it will be understood that trouble may arise during slack day periods and during the night if the switch of the first available idle trunk circuit should be faulty and unable to complete the call. Repeated calls on the part of the caller are of no avail as he continues to pick up the same switch. His only hope of getting through rests upon the chance of another subscriber calling and engaging the faulty connector for the time being, and with the same result. In order to avoid annoyance in this respect, the first three "B" switches in each hundred group of the Lorimer are made rotational, *i.e.* when the No. 1 "B" switch is picked up it remains engaged after the clearing signal is given. The next call will pick up No. 2 switch which remains engaged after the clear signal is received. The third call picks up No. 3 switch, which, when operated, breaks the electrical locking arrangement and releases the first two switches.

In the circuit (37) No. 1 switch is shown engaged, with *J* 14 and B 4 in contact. Relay *A* will have been operated *vid R* 40, 300, *A*, right-hand back contact, *B* 7, *J* 14, *B* 4, *S* 14 to earth at signal controller, and then locked by its own armature as shown. The



Digitized by Google

clutch magnet circuit is thus made independent of contacts *B* 4 and *J* 14, and so long as *A* remains energised, *S* 14 is kept in the engaged condition, battery being applied *viâ* 1, B 7, 500, 400 to S 14, and this condition is maintained after the " B " switch has been restored to normal at the completion of the conversation. When No. 2 in its turn is engaged, the circuit conditions will be similar to No. 1. When No. 3 is picked up relay *C* operates and breaks battery from *R* 40 armature, and relays *A* and *B* de-energising, remove the engaged condition from *S* 14.




No 1 B Switch test circuit S14 shown engaged

2633

37.—Rotational Selection of Switches.

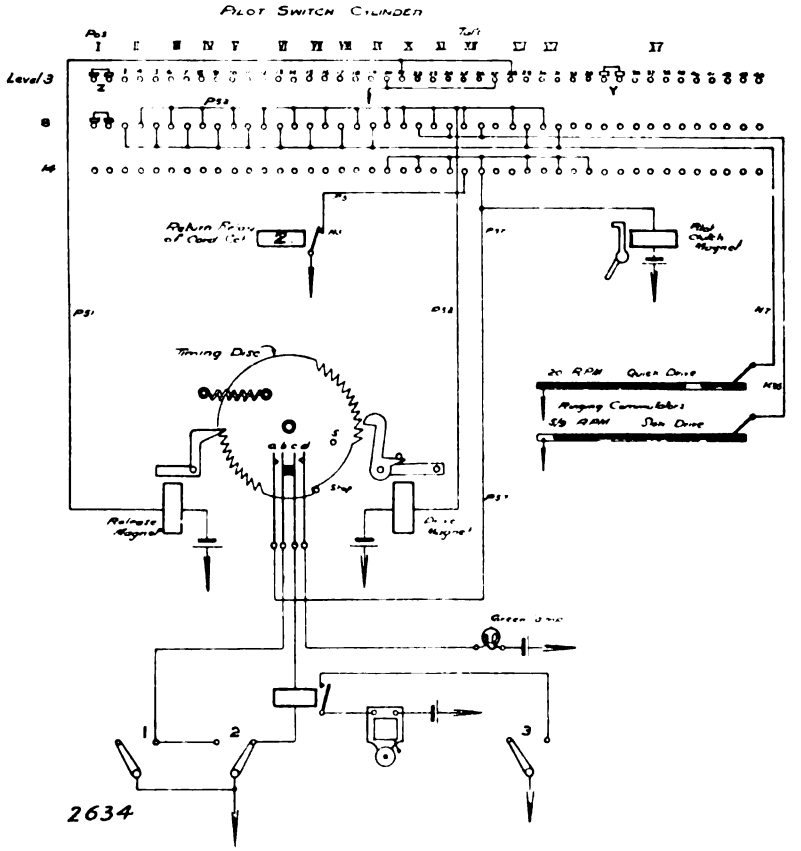
This rotational system has a certain disadvantage if all seven switches in a switch-board were joined up for rotational operation, for it is possible that trouble may occur during the busy hour when calls are following each other closely. Assume a case where the first six switches have been engaged, and although the first two have actually released, the busy test is still on Nos. 1 to 6. If two calls come in, one close behind the other, the wipers of the interconnectors proceed to test the trunks. The first one will reach the seventh trunk, engage it, and cause the release of the first and second switches.

If the wipers of the second interconnector have passed over these



Digitized by Google

trunks before they are released they will fail to find an idle circuit. Hence it is considered preferable to arrange only the first three switches for rotational working, as these are quite sufficient for the slack period when this special arrangement for ensuring the success of a repeated call is necessary.




38.—Supervisory and Timer.

*Rotational selection of connective cord circuit divisions*, as already explained, is arranged for by the movement of the division starter.

### Supervisory and Timing Device.

**The supervisory and timing device** in connection with the pilot switch is shown in 38 and 41.

**Delay in operation.**—As the brushes on level 8 pass from position I to position IX they bridge across the various contact points of level 8, closing the drive magnet circuit *viâ P* 52 *N* 7 and the quick drive commutator, which sends out impulses at the rate of twenty per



Digitized by Google

minute, thus operating the drive magnet, whose armature pulls the disc round notch by notch. Should there be any abnormal delay in reaching position IX, the disc will have been turned round so that the striker pin "*S*" presses *d* against *c*, thereby closing the circuit of the green supervisory lamp and alarm relay. At the next step the striker pin is further advanced and pressure is also imparted by means of the coupled springs *c*, *b*, to the two left-hand springs; *a*, *b*, make contact and if switch 1 be thrown over, the pilot clutch circuit is closed *viâ P* 57. If the delay has been caused by failure of other switches, the clutch operates and moves its brushes forward to position X.

As the bridged brushes on level 3 pass from position IX to X they close the release magnet circuit *viâ P* 51, 21, 20 and earth. The operation of the magnet armature releases the detent and the disc is pulled back to normal by the spring. During the day-time when the attendant is on duty the switches will be in the positions shown. The pilot switch release circuit *P* 57 would be disconnected. The attendant's attention is therefore directed to the failure and he proceeds to investigate the cause of the trouble. Generally speaking, the release is only automatically effected when the attendant is off duty.

If the brushes pass forward in their normal time, they reach position x before the alarm can operate. The brushes on level 3 bridge contacts 20 and 21, and close the release magnet circuit and the disc is restored to normal and no alarm given.

### Time Limit of Conversation.

On reaching the talking position xii, the drive magnet circuit is closed *viâ P* 52, 25, 26, *K* 35 and the slow drive commutator which sends out 5 impulses in nine minutes; the notch drive is pulled round accordingly. The striker pin "*S*" presses the springs into contact as before, and if switch 1 is over, the circuit of the pilot switch clutch is closed and the pilot brushes move from the "talk" to the "release" position, thus severing the conversation.

As previously explained, the time-limit can be increased if necessary. The striker pin can be shifted so that it will take about twenty minutes to reach the alarm contacts when the pilot switch is in the talk position.

*Failure to release.*—Similarly, should the pilot switch wipers not pass forward from the release positions 13 and 14, the circuit of the drive magnet is closed *viâ P* 52, *N* 7 and the quick drive commutator, and the alarm is given. It will be noticed that there is an additional wiper "*Y*" on level 3, which moves in unison with "*Z*," following it at a distance of ten contact points. When wiper "*Z*" has



Digitized by Google

passed position 15, "*Y*" will close the release magnet circuit *viâ* *P* 51, 28 and 27, and so effect the release of the disc.

*Division starter.*—A timing device is also provided for the division starter. As will be seen by reference to **47**, the drive magnet finds a circuit *viâ* *E* 31, 19 × 7 – 19 × 8, *E* 36 to *H* 6 fast drive 20 r.p.m., in **41**. If the wipers stopped for an abnormal period on, say, position 1 because the pilot switch of connective division 1 failed to respond, the disc will be pulled round, and the clutch magnet circuit closed *viâ* *J* 3, *J* 1, *E* 38 and earth. The release magnet is operated when the wipers pass from a stop position to the next wait position, the circuits being *viâ* *E* 35 and the bridged wipers of levels 8 and 7 to earth.

When all the connective divisions are engaged and a call comes in, the wipers will pass forward from normal to the out of service (O.S.) position and wait there. No alarm signal is shown in the diagram for this position, but there are sufficient contacts to arrange for this if desired.

There are two other supervisory lamps for each connective division, as in **41**.

The red lamp is connected to the following contact points of the pilot switch: level 4 contacts 33 and 38; level 5 contact 13; level 7 contacts 4, 6, 8, 12, 16, 28, 30, 32, 36, 42, and 44. The white lamp is connected to level 7 contacts 22 and 24. The red lamp glows during the period the pilot wipers are moving from positions 2 to 9, *i. e.* during the period of setting up a connection. The white lamp glows at the ringing position 10. The white and red lamps glow at position 11, but darken at the "talk" position 12. The red lamp glows again at release positions 13 and 14.

As these lamps are placed above their respective connective divisions, the attendant is able to watch a call pass forward from point to point.

The wait position 11 is arranged for possible cases where the calling subscriber turns the crank handle but does not lift his receiver, a practice in which some may indulge in order to hear the clicking of the mechanism. The white and red signal lamps call attention to this practice. Subscribers on other automatic systems sometimes amuse themselves by dialling their own number to get the busy tone. It costs them nothing as their meter does not register, but it helps to block the outlets for others.

## Party Lines.

*Reverting calls, i. e.* ringing up another station on the same line.

The number is set up and the crank turned as for an ordinary call. The first or thousands lever determines the ringing signal to be applied, as explained in connection with **33**.



Digitized by Google

By referring to **40** it will be seen that the thickened lines *P* 12 and *P* 13 cannot be joined through to the cord relay circuits *P* 3 and *P* 1 until the wipers reach position 9, hence the ringing impulses upon the calling line do not reach the cord relays, and although the calling station's receiver may be off it cannot affect the testing and first ringing, since the ringing circuit upon a party line is from both line wires to earth, and not round the line loop.

The line is tested and found idle at the moment between the breaking of the preliminary guard circuit and the closing of the final guard circuit, the wipers of the third level of **40** being then passing points 12 × 3 — 13 × 3, and not connecting *P* 14 to *P* 88.

The first code ring signal is, therefore, sent out, and the pilot switch moves to position 9. It will doubtless be noticed that an ordinary subscriber can thus ring his own bell by the same process if he should wish to demonstrate the working of his instrument. At position 9 the calling station's receiver loop operates relays 1, 2, 3 and 4 of the cord circuit **34**, and causes the pilot switch to move to the talking position 12.

If the called station does not respond to the first ring the caller must call again in the usual way.

### Meters at Party-line Stations.

The Lorimer practice is to arrange the connections and mechanism at the subscriber's telephone so that the turning of the crank handle short-circuits the transmitter. On hearing the called party reply, the calling station presses the meter button, which mechanically causes it to register, and also breaks the short circuit across the transmitter. If no reply is received the restoration of the receiver effects the release without registration.

### Coin-box Stations.

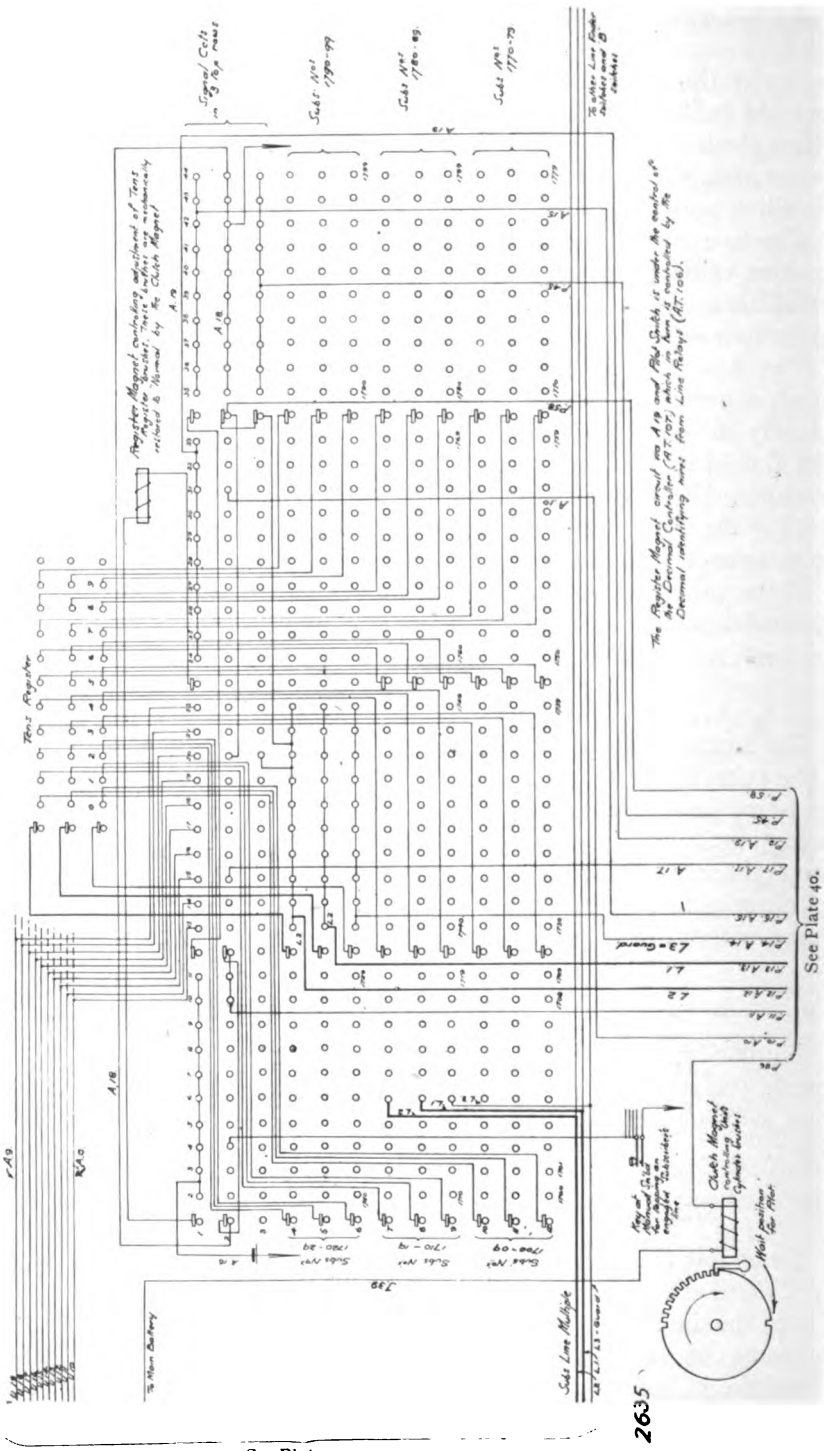
Similar arrangements are made where coin boxes are fitted. On hearing the reply the calling station deposits the necessary coin or coins, which mechanically break the short-circuit across the transmitter.

## Offering Circuits from Manual Switchboard.

To enable the operator to tap an engaged circuit, an earthing key is provided at the manual switchboard as indicated in **39**. Incoming calls to the automatic exchange from the manual board are passed over one of seven lines, say 1702, 1712, 1722, etc., to 1762. When the called circuit is found to be busy the signal controller stops at contacts 43 and the operator receives the busy tone. She



Digitized by Google

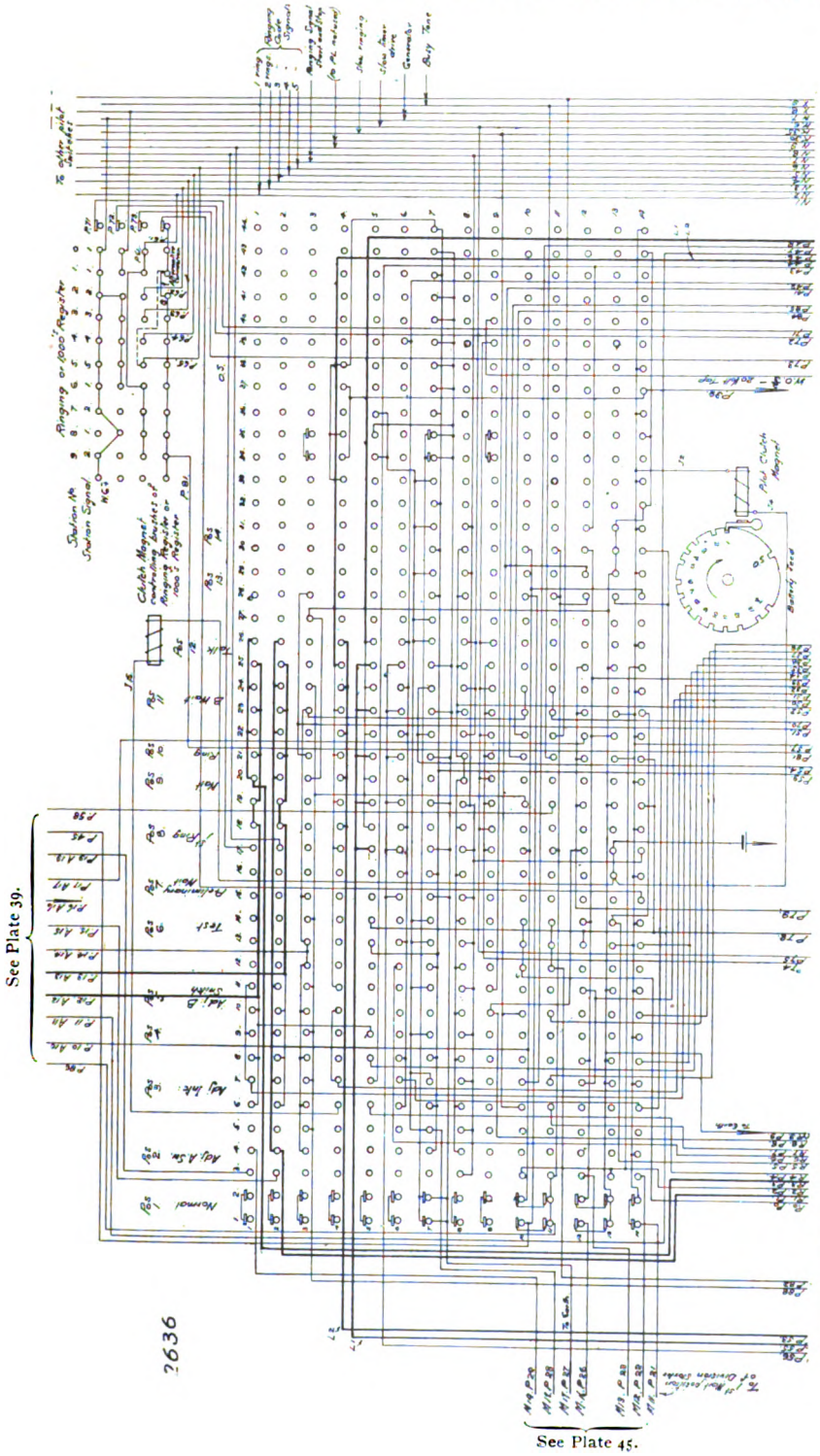

Test Register
Register Magnet controlling adjustment of Test Register Contact Switches, these Switches are mechanically reduced & Normal by the Clutch Magnet
Signal Coils in 9 Box rows
Subs 1st 1780-89
Subs 1st 1790-99
Subs 1st 1770-79
To other Line Finder Switches of Group B
The Register Magnet circuit via A 18 and Test Switch is under the control of the Decimal Controller (A.T. 107) which in turn is controlled by the Decimal Identifying wires from Line Relays (A.T. 106).
See Plate 40.
Subs Line Multiple
To Main Battery
Clutch Magnet controlling Test Switches Brushes
Wall Position for Main
2635

39.—A OR LINE FINDER SWITCH.

See Plate 44.



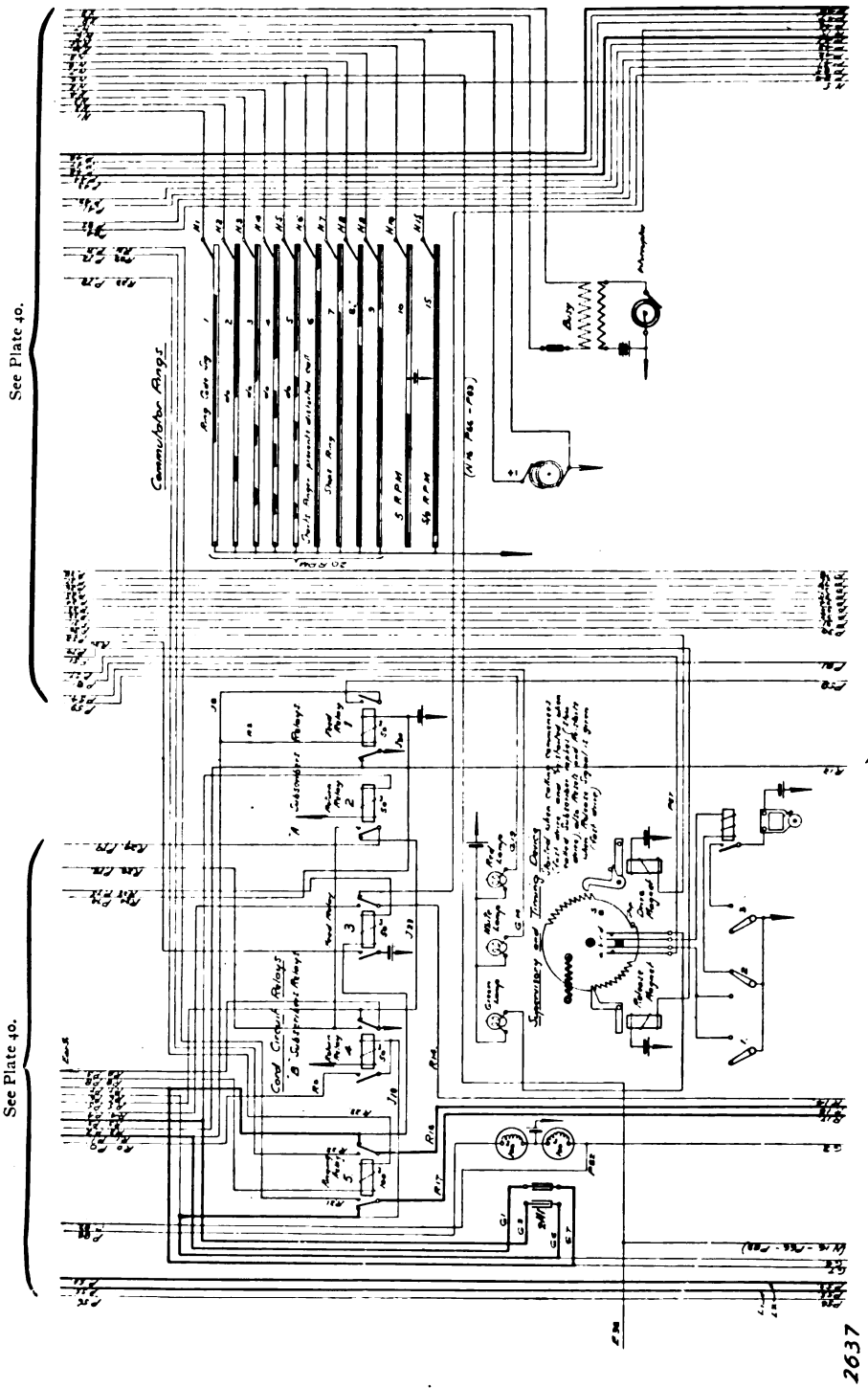
Digitized by Google




**40.**—Pilot Switch and Ringing Register.



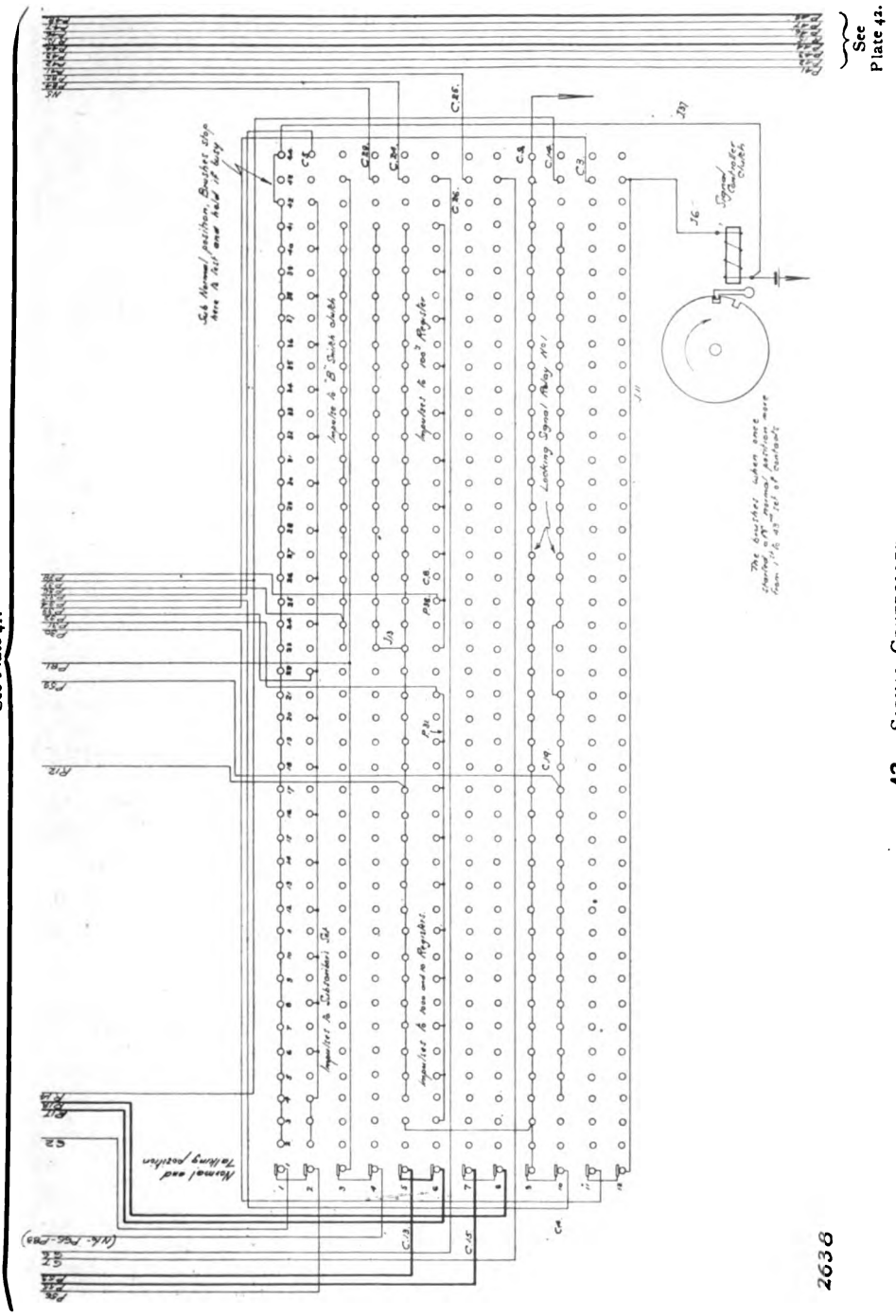
Digitized by Google




41.—Timer and Commutator Circuits.



Digitized by Google

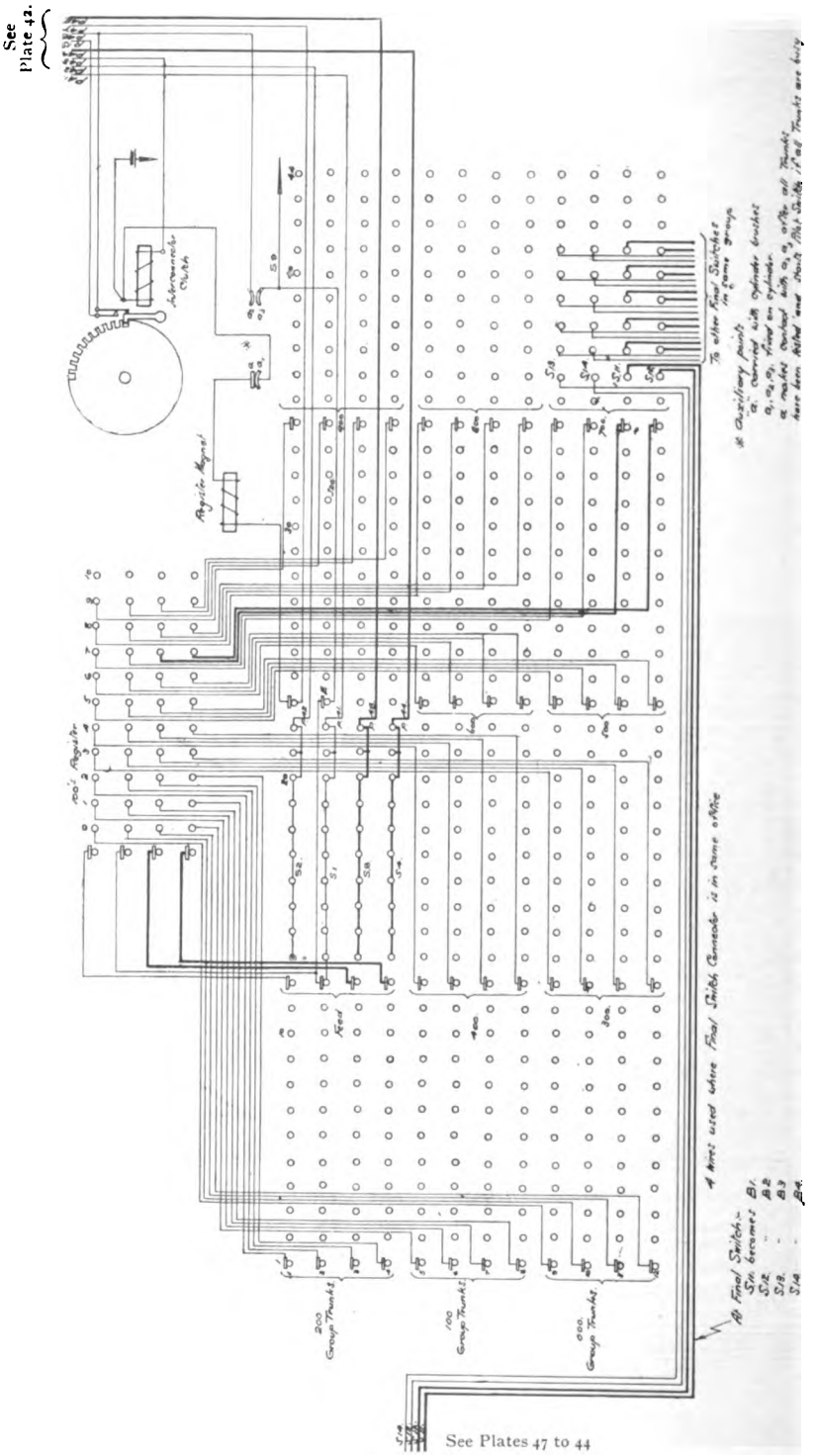



**42.**—SIGNAL CONTROLLER.

2638



Digitized by Google

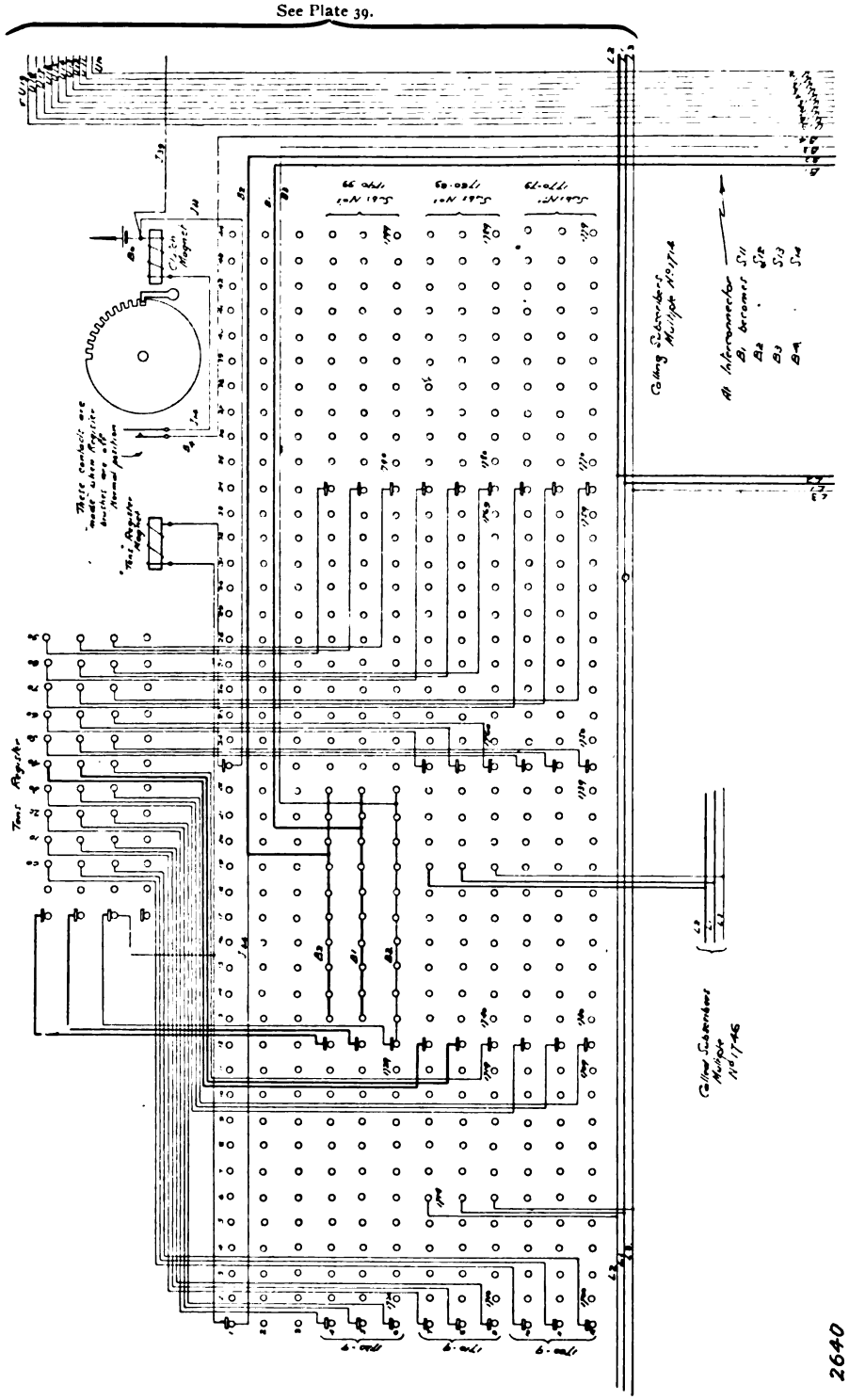



43.—Interconnector Switch and Hundreds Register.

2639



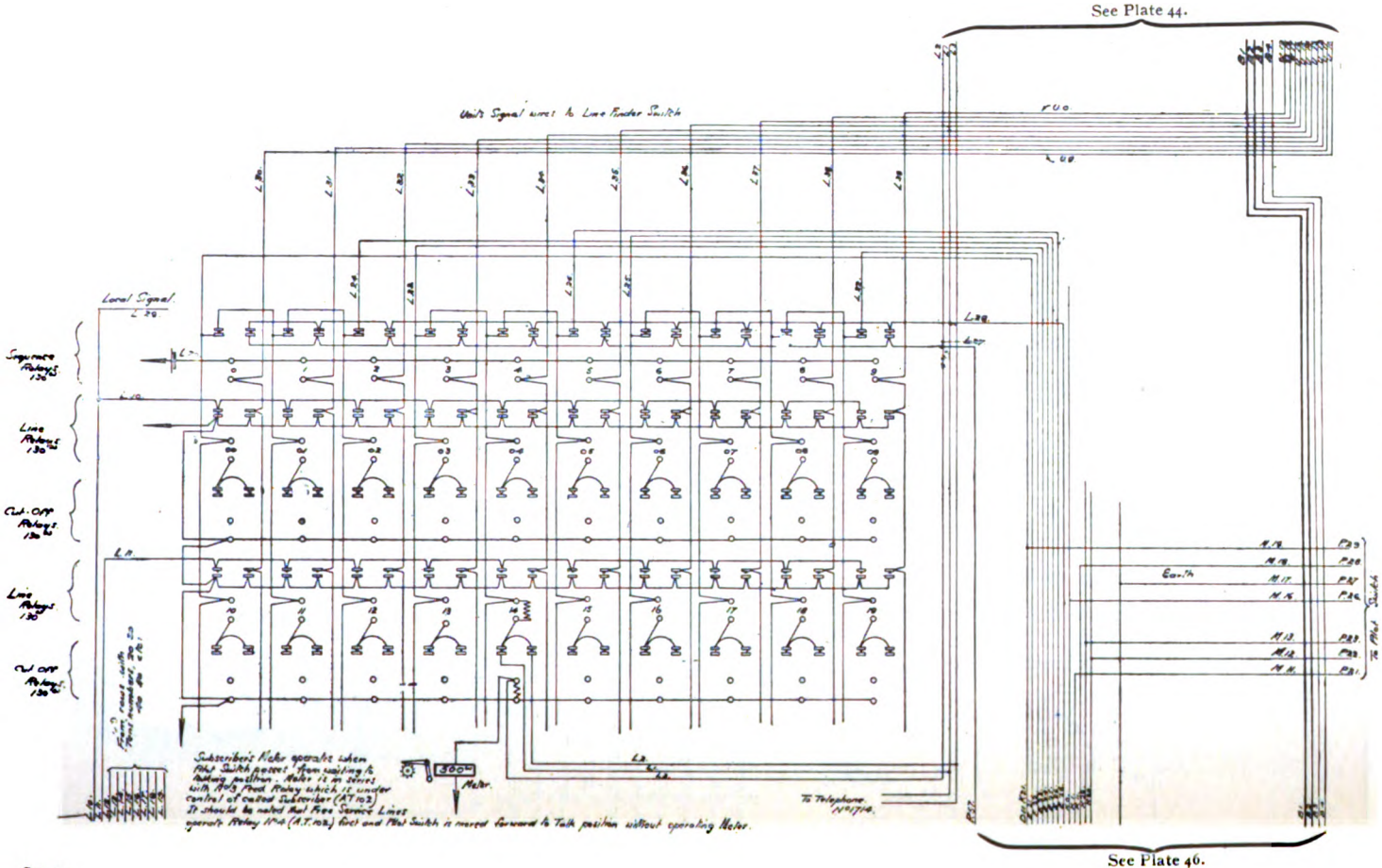
Digitized by Google




44.—"B" or Final Switch and Tens Register.



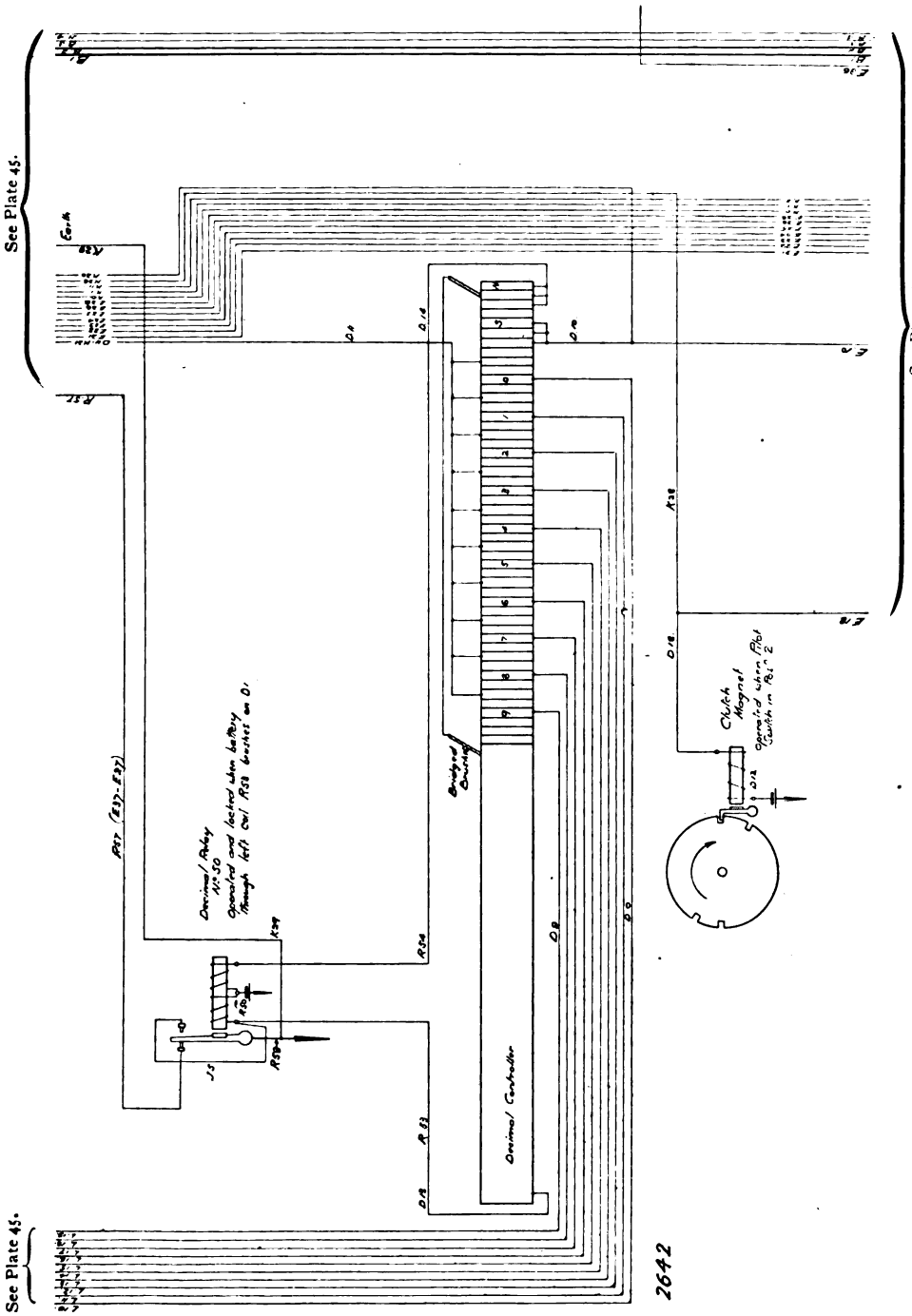
Digitized by Google




45.—Relay Call Indicator.



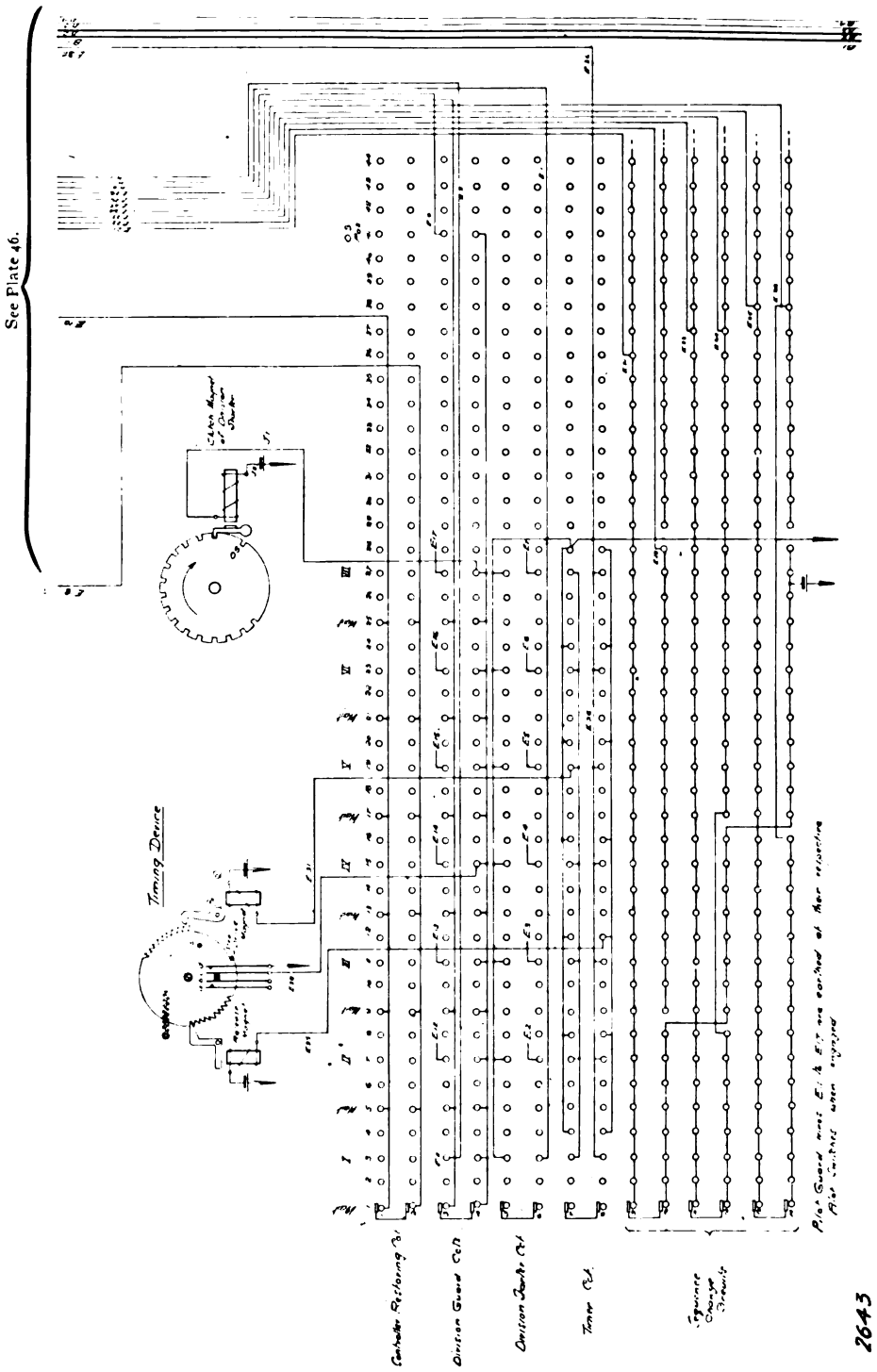
Digitized by Google




46.—Decimal Controller.



Digitized by Google




47.—Division Starter.



Digitized by Google

then presses the common earthing key which closes the signal controller clutch magnet circuit *viâ* *J* 6, 43 × 12—43 × 11, *P* 33, 22 × 13—22 × 12, *P* 17, *A* 17 line-finder switch, and earthed key (**42, 41, 40** and **39**). This advances the signal controller wipers to normal and joins the manual switchboard circuit through to the called subscriber.

### Free Service Lines.

As already explained in connection with **34** the calling subscriber's meter is operated at position 11 of the pilot switch in conjunction with relay 3. If this relay is not energised at that time, no registration will take place.

On a free service line, current is applied to line 2 in such a way that relay 3 is not energised in position 11, therefore the main battery is not applied direct to the guard wire of the calling line, but the 110ω resistance coil is interposed and the meter remains inoperative.

Space limitations do not permit of any description of the manual switchboard circuits. They consist of the usual incoming and outgoing lines, and arrangements have been made so that the called subscriber on the automatic system can flash the operator into circuit without breaking down the connection when through on a call *viâ* the manual switchboard.

---

## TELEPHONE PROGRESS IN LONDON.

By C. W. Muirhead.

In the review of the Post Office telephone progress in London for the year ended March 31st, 1912, which appeared in the Post Office Electrical Engineers' Journal a year ago, reference was made to the events which preceded the transfer to the Post Office of the National Telephone Company's undertaking. The recommendations of the Select Committee of 1898 and the Telephone Act of 1899 led to the inauguration in 1902 of a Post Office telephone system in London—a system which attained substantial proportions in the short period of its separate existence before the amalgamation with the National Telephone Company. In less than ten years the Post Office established thirty-three exchanges and joined up over 77,000 exchange stations, a figure which did not compare unfavourably with the figure of 131,000 stations obtained by the Company in, of course, a much longer period of time.

When the transfer took place the total number of exchanges—Post Office and National—was 95, 33 being Post Office and 62



Digitized by Google

National. At the close of the year now under review—viz. March 31st, 1913—the total number of exchanges was 80. The reason for the decrease is that the Post Office, finding that it could serve certain neighbourhoods catered for by National exchanges from its own exchanges, closed the former exchanges and transferred the subscribers' circuits. The exchanges closed were mostly in suburban districts, such as Barnet, Epsom and Harrow, and the transfers to the neighbouring Post Office exchanges were carried out with a minimum of inconvenience to subscribers. In many cases, indeed, where it had been possible to reserve numbers for the National lines the operations were effected without even changing the number of the subscribers, who could, therefore, regard the proceedings with a certain amount of equanimity. In addition to these operations the Post Office opened during the year two new exchanges—the Park Exchange and the Regent Exchange—to which it transferred the circuits of a number of subscribers who were being served from other exchanges. In these cases, as change of number and designation of exchange were involved, the proceedings were regarded with less favour by the subscribers concerned.

The following list shows the eighty exchanges existing on March 31st, 1913, and the lines and stations connected with them :

*Lines and Stations working at March 31st, 1913.*

| Exchange. | Lines. | Stations. | Exchange. | Lines. | Stations. |
|---|---|---|---|---|---|
| Avenue . . | 5368 | 11442 | Erith . . | 138 | 199 |
| Bank . . | 1639 | 3772 | Esher . . | 242 | 270 |
| Barnet . . | 532 | 622 | Finchley . | 1344 | 1551 |
| Bartholomew House . | 493 | 582 | Gerrard . . | 7571 | 20775 |
| Battersea . | 1941 | 2440 | Hammersmith | 1253 | 1677 |
| Bexley Heath . | 152 | 176 | Hampstead . | 5923 | 6902 |
| Brixton . . | 2085 | 2499 | Harrow . . | 437 | 517 |
| Bromley . | 1598 | 1857 | Holborn . | 4821 | 10474 |
| Burgh Heath . | 185 | 205 | Hop . . | 3916 | 6826 |
| Central . . | 11372 | 19755 | Hornsey . | 1866 | 2083 |
| Chigwell . | 39 | 44 | Hounslow . | 227 | 266 |
| Chingford . | 91 | 94 | Ilford . . | 565 | 666 |
| Chiswick . | 1254 | 1482 | Kensington . | 4407 | 6868 |
| City . . | 7392 | 13228 | Kingsbury . | 90 | 108 |
| Cray . . | 85 | 87 | Kingston . | 1499 | 1881 |
| Croydon . | 1996 | 2479 | Lee Green . | 1517 | 1735 |
| Dalston . . | 2665 | 3369 | London Wall . | 8485 | 18673 |
| Dartford . | 104 | 247 | Loughton . | 122 | 139 |
| Ealing . . | 1381 | 1606 | Malden . . | 118 | 130 |
| East . . | 2719 | 4227 | Mayfair . . | 5481 | 8314 |
| East Ham . | 520 | 647 | Merstham . | 68 | 74 |
| Enfield . . | 457 | 543 | Mitcham . | 94 | 116 |
| Epsom . . | 381 | 443 | Molesey . . | 251 | 279 |
| | | | New Cross . | 1637 | 2201 |



Digitized by Google

| Exchange. | Lines. | Stations. | Exchange. | Lines. | Stations. |
|---|---|---|---|---|---|
| North . . | 3489 | 5187 | Sutton . . | 955 | 1082 |
| Official Switch | 320 | 418 | Sydenham . | 1864 | 2239 |
| Paddington . | 6201 | 9955 | Tilbury . . | 184 | 236 |
| Palmer's Green | 593 | 686 | Tottenham . | 703 | 1017 |
| Park . . | 1403 | 1741 | Treasury . | 177 | 263 |
| Purley . . | 627 | 675 | Trunk . . | 121 | 151 |
| Putney . . | 1982 | 2293 | Victoria . . | 5903 | 13155 |
| Rainham . | 33 | 43 | Waltham Cross . | 164 | 230 |
| Redhill . . | 377 | 455 | Walthamstow . | 628 | 794 |
| Regent . . | 2111 | 4188 | Wanstead . | 504 | 569 |
| Reigate . . | 229 | 276 | Wembley . | 143 | 168 |
| Richmond . | 1359 | 1623 | Western . . | 5223 | 6569 |
| Romford . | 187 | 231 | Willesden . | 1420 | 1675 |
| Sidcup . . | 264 | 293 | Wimbledon . | 1331 | 1564 |
| Southall . . | 128 | 259 | Woodford . | 263 | 294 |
| Stratford . | 739 | 889 | Woolwich . | 573 | 783 |
| Streatham . | 1478 | 1663 | | 138197 | 226234 |

The total figures compare as follows with the corresponding figures for the preceding year:

| | Stations. |
|---|---|
| Year ending March 31st, 1913 . . . . | 226234 |
| ,, ,, 1912 . . . . | 211503 |
| Increase . . . . | 14731 |

The increase may be regarded in the circumstances of the case as satisfactory, although it is not so good proportionately as the increase on the Post Office system for each of a number of years before the transfer. Account must of course be taken in regarding these figures of the fact that the capacity of a large number of ex-National exchanges was exhausted or was approaching exhaustion at the time of the transfer. Endeavour to secure new subscribers in the neighbourhoods served by these exchanges had consequently to be relaxed. On completion of new exchanges now in course of construction and of various switchboard extensions at existing exchanges the rate of increase will be accelerated.

One of the exchanges at which new equipment was introduced was Epsom. In this case it was provided, not because of exhaustion of switchboard accommodation, but because the Post Office considered the time had arrived to test in actual working one of the approved systems of automatic telephony. Epsom was chosen for the experiment for various reasons, the chief being its high percentage of local calls. The installation provided is of the Strowger type, of which the essential features, now very well known, are the line switch associated with each subscriber's circuit, which—operated



Digitized by Google

when the subscriber lifts the receiver—connects the line with a disengaged first selector; the first selectors, 10 to each 100 subscribers' lines, which—operated by means of the number dial at the subscriber's premises—give connection to a disengaged connector associated with the particular hundreds group containing the required subscriber's line, and the connectors, which—raised to the desired tens level and then to the units by means of the second and third operations of the number dial—give connection to the particular line required. The Epsom installation, which is designed to accommodate 500 subscribers' lines, was brought into use on May 18th, 1912, and a Niagara of information on automatic telephony, with particular reference to the Epsom experiment, was poured out from the pages of the following issue of the POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

A few weeks after the completion of the Epsom installation the work of converting into an automatic exchange the "official switch," the exchange serving the various departments of the Post Office, was completed. The exchange is of the same type as that provided at Epsom, except that the devices for registering calls are absent, and the facilities for obtaining communication with the public telephone system are less extensive. The capacity is for 400 lines, and each number is able to obtain communication automatically with the Central Exchange, through which access to the public system is secured.

The experience gained from these two experiments and the enquiries made into full and semi-automatic working at other places where systems have been tried show conclusively that automatic exchange working has come to stay. The present generation of telephone operators need not, however, fear transfer to other spheres of labour because of the advent of the latest labour-saving device in telephony. The transition from manual to automatic switching will be a very gradual one. Especially will this be the case in London, where the problems affecting the question are numerous and complex. In America automatic telephony would have spread more rapidly had it not been for the existence in every large community of the expensive common battery exchange, which is still youthful and flourishing, and which could only be substituted at considerable cost. In this country, outside London and some of the larger cities, the exchanges are of the older magneto type. Proposals to substitute them by automatic exchanges are naturally unattended with the same financial problems.

The total number of removals carried out for subscribers during the year ended March 31st, 1913, was 19,005. It will be seen from the following table that the percentage of removals to stations remains fairly constant.



Digitized by Google

| | Stations. | Removals. | Percentage of removals to stations. |
|---|---|---|---|
| 1909 (Post Office) | 60,091 | 5,458 | 9·08 |
| 1910 ,, | 69,035 | 6,226 | 9·01 |
| 1911 ,, | 77,317 | 6,830 | 8·83 |
| 1912 ,, and National) | 226,234 | 19,005 | 8·89 |

The total number of cessations during the year was 11,425. This is a large number, even when the size of the combined system is taken into account. The following table shows the reason for the cessations so far as it is possible to analyse them:

| Bankruptcies. | Business bad. | Deaths. | Giving up business. | Exhibition lines. | Leaving area. |
|---|---|---|---|---|---|
| 457 | 711 | 189 | 1089 | 148 | 846 |

| New installations. | Removed (address unknown). | Solicitor's instructions. | Removals, in connection with. | Transfers to other exchanges. | Miscellaneous and unanalysed. |
|---|---|---|---|---|---|
| 230 | 2914 | 496 | 186 | 24 | 4135 |

For each of the three years preceding the transfer the cessations on the Post Office system numbered less than 3000. The combined system is three times as large as the Post Office system, and if approximately the same ratio had been maintained the cessations during the year would have been about 9000. With a larger system a greater percentage of cessations to new lines was, however, to be expected. It is a feature which is prominent in the larger American systems, where the percentage of ceasements to new business is sometimes as much as 60. In London the percentage last year was a little over 40. Apart from the general tendency referred to there were two important contributing factors to the disproportionate increase in cessations in London during the year as compared with the new lines. The first was the reduction in the length of notice required to determine agreements signed with the National Telephone Company. The Post Office has always been more generous than the Company with regard to length of notice, and it took an early opportunity after the transfer to extend its short notice system to subscribers who held National agreements. The second reason was the exhaustion of plant at so many ex-National exchanges, a circumstance which reduced for the time being the rate at which new lines were joined up and therefore swelled the percentage of cessations to new circuits.

The work of fusion in London has been a heavy one, and does not receive adequate tribute from the mere statement that some 130,000 telephone stations were transferred to Post Office control, and a staff of nearly 5000 brought under Post Office conditions. It may fairly be claimed that, having regard to the enormous amount of work involved, the task has been performed creditably. Most of



Digitized by Google

the difficulties which arose were inevitable to a work of such magnitude, some of them were peculiar to the circumstances of the present case. Reference may again be made in the latter connection to the exhaustion of switchboard accommodation at a number of transferred National exchanges. In some of these cases new switchboards had to be provided; in other cases, where the floor accommodation was not sufficient for additional switchboards, new exchange premises had to be secured.

There was, and still is, delay in providing circuits in certain districts due to the above-mentioned causes. Comparatively few complaints were, however, received on this account, and when they were made the causes for delay were easily explainable and easily understandable. Criticism of the Post Office was almost entirely directed against the quality of the service, which, according to some critics, suddenly and sensibly deteriorated under Post Office management. We were asked to believe that ex-National exchanges, working under precisely the same conditions as obtained before the transfer, with the same operators, the same supervisors, and the same switchboards, underwent some strange blighting influence as soon as they became Post Office property. A miasma of apathy and inefficiency settled upon them. Like the Church of Laodicea they became affected by the spirit of indifference. The situation was, indeed, worse, for whereas the failing which distinguished, and finally extinguished, the Church of Laodicea was confined to its own body, the disease in the case under diagnosis spread in some mysterious and hitherto unexplained way to exchanges which had always been Post Office exchanges, and which, so far as human eye could see, should have been in no way affected by the transfer.

While it is true that the closing of National exchanges, the transfer of subscribers' circuits to other exchanges, the re-arrangement of operators' loads, and the temporary overloading of positions at exchanges where switchboard accommodation was scarce, reacted to some extent on the service, it is clear that there was a tendency to overstate the case against the Department. It is not suggested that disapproval of the principle of State control found expression, even unconsciously, in the criticisms. It is possible, however, that, given precisely the same quality of service, a good many complaints would not have been made had the Company, and not the State, been responsible. Essentially reasonable in its attitude towards the individual, the British public inclines to be insistent and unsparing when dealing with a public body. From the tone of some of the criticisms it might easily have been imagined that the National Telephone Company had been all that was ideal in its administration, that it had been taken over by an administration which had shown itself inefficient in the past in telephone management. The



Digitized by Google

severe and persistent criticism of the Company's administration which led to the appointment of the Select Committee of 1895 was forgotten, as were the rapid developments in the trunk telephone system after the State acquisition in 1896, and in the London telephone system since the entrance into the field of the Post Office in 1902, with the popular message rate subscription and its liberal treatment of subscribers as regards conditions of agreement.

The control of the telephone service of the country is now in the hands of a department which admittedly gives the best postal and telegraphic service in the world. It is hardly likely that an administration which serves the public so admirably in these two fields will fail in its efforts to foster and improve the telephone service. It is hardly likely that, with an administration which has done so much to popularise the telephone in London and the provinces in the past, there will be economy of effort to meet the demands of the future. The public on its side will no doubt exercise reasonable patience, and give that consideration which it would give to a private firm to which has been entrusted the management of an enormous and intricate business.

---

## THE TELEPHONE STATIONS OF THE WORLD AT THE BEGINNING OF 1912.

By W. H. GUNSTON.

To obtain precise statistics of recent date concerning the telephone systems of the world is a practical impossibility, while to obtain a reliable approximation is a matter both of patience and difficulty. So long as we are confined to Europe and Australia, where the majority of telephones are under State administration, and to Asia, where more than three quarters of them are State owned, the task of obtaining statistics from six months to two years old is not an insuperable one. It is when we come to the continents where private companies predominate that press cuttings and diverse records have to be ransacked to obtain a trustworthy estimate of the present state of development in those parts of the world. It is not only that some private companies are not very willing to furnish statistics of their development, but also that in some states, as in the United States, Brazil, Mexico and elsewhere, these companies are so numerous that it is almost impossible to apply to them all for information. Fortunately in the United States the bulk of the telephones are operated by the American Telephone and Telegraph Company and its connections. This corporation prepares for its own use admirable statistical returns, to which I am indebted for



Digitized by Google

much valuable information. As regards Canada, the Dominion Government publish a return of telephone statistics which includes those of private companies as well as of the State system. It is thus possible to obtain accurate figures for nearly the whole of Europe and fairly precise figures for North America, which continents between them account for more than eleven twelfths of the telephones in the world. As regards Asia, South America and Africa, the statistics I shall exhibit are qualified by estimates which will be duly designated. The figures obtained for Australia, Russia, Italy and some smaller states are those for January, 1911; estimated figures for January, 1912, are therefore resorted to.

## The Telephone Development of the World.

### Europe.

Table I shows the number of telephones in Europe and the proportion of Telephones to inhabitants. It will be seen that

Table I.—*Europe.*

| Europe. | No. of exchanges. | No. of call offices. | No. of stations. | Population (thousands) | Population per telephone. |
|---|---|---|---|---|---|
| Denmark, March 31st, 1912 | 1043 | 1912 | 107,153 | 2589 | 24 |
| Sweden | 2201 | 3125 | 199,690 | 5522 | 28 |
| Norway—State, June 30th, 1911; Private, December 31st, 1910 | 1173 | 3110 | 62,940 | 2370 | 38 |
| Switzerland | 427 | 1298 | 84,058 | 3463 | 41 |
| Germany | — | 14,034 | 1,154,518 | 64,926 | 56 |
| | *6708* | | | | |
| Great Britain and Ireland | 2808 | 12,674 | 701,082 | 45,365 | 65 |
| Luxemburg | 90 | 269 | 3575 | 260 | 73 |
| Iceland (est.) | — | — | 900 | 78 | 86 |
| Netherlands | 796 | 1246 | 65,314 | 5945 | 92 |
| France | 9341 | 15,562 | 260,998 | 39,252 | 150 |
| Belgium. | 248 | 252 | 42,101 | 7516 | 179 |
| Austria | 1311 | 2226 | 127,293 | 28,568 | 224 |
| Roumania | 945 | 3212 | 19,438 | 6700 | 298 |
| Italy (est.) | — | — | 76,000 | 33,910 | 446 |
| | *219* | *1048* | | | |
| Hungary | 1731 | 2263 | 36,183 | 19,254 | 532 |
| Spain | 113 | 142 | 26,747 | 19,712 | 737 |
| Portugal (est.) | — | — | 6900 | 5423 | 786 |
| Servia (est.) | — | — | 3000 | 2700 | 900 |
| | *34* | *54* | | | |
| Russia (est.) | — | — | 170,000 | 163,778* | 963 |
| | *190* | *592* | | | |
| Bulgaria | 16 | 39 | 2801 | 4035 | 1440 |
| Greece | 6 | 3 | 1760 | 2632 | 1500 |
| Bosnia-Herzegovina | 20 | 25 | 802 | 1828 | 2279 |
| Total in Europe | — | — | 3,153,000 | 400,000 | 126 |

* Including Russia in Asia.



Digitized by Google

Denmark, Sweden, Norway, Switzerland and Germany occupy the best positions in the order named, closely followed by Great Britain, sixth on the list. The figures for Russia, Italy, Roumania, Servia and Portugal have been estimated on the basis of the figures for the last two years. The figures in italics are those up to the end of 1910 obtained from the *Journal Télégraphique*.

## ASIA.

*Japan* and the *British* and *Dutch Indies* are the principal States using the telephone in Asia. The figures for those countries are official, the telephone stations of the remaining countries, which are unimportant in point of number, being estimated. It has not been thought necessary to show the relation of these few hundred thousand telephones to the millions of inhabitants of India, China and Japan.

TABLE II.—*Asia.*

| Asia. | No. of exchanges. | No. of call offices. | No. of stations. |
|---|---|---|---|
| Japan | 856 | 2508 | 159675 |
| Chosen, Formosa and Sakhalin (est.) | — | — | 11500 |
| India | 190 | — | 13154 |
| Netherlands, East Indies | 149 | 40 | 9735 |
| China and Hong Kong (est.) | — | — | 8000 |
| Indo-China (French) (est.) | — | — | 900 |
| Siam (est.) | — | — | 700 |
| Singapore (est.) | — | — | 1700 |
| Total for Asia | — | — | 205000 |

## AFRICA.

The most noteworthy telephonic development is in the *Union of South Africa*, where there are 18,672 subscribers' stations. Of these, 6150 are in Johannesburg, 2629 in Cape Town, and 1542 in Pretoria.

*Tunis* has about 7000 telephones. Those for *Algiers* are probably included in the total for France.

In *Egypt* the system is in the hands of a company. Figures are difficult to obtain, but the total may be estimated at about 9000.

In Madagascar, Dahomey, French Guinea, Angola and the German Colonies there are about 1000 telephones, and the total for the whole of Africa, excluding Algiers, may be computed at about 36,000.



Digitized by Google

| | |
|---|---|
| Egypt | 9000 |
| Tunis | 7000 |
| South Africa | 18700 |
| Madagascar, French, German, and Portuguese Colonies | 1300 |
| | 36000 |

## North America.

Table III gives the figures for North America. Estimates had to be resorted to in the case of Mexico and the West Indies and of the independent companies in the United States. The "Bell-connected" stations are those of subscribers to independent companies which have connection with the Bell system. With those of the American Telephone and Telegraph Company's sub-licensees they total 6,632,625, and have increased by 749,906 since the beginning of 1911. The figures for Canada apply to June 30th, 1912. Of the total stations, 148,543 belonged to the Bell Company of Canada.

TABLE III.—*North America.*

| America. | No. of exchanges. | No. of stations. | Population (thousands). | Population for telephones. |
|---|---|---|---|---|
| United States: | | | | |
| Bell | 5014 | 4474171 | | |
| "Bell-connected" | — | 2158454 | | |
| Other Independents | — | 1725000 | 92174 | 11 |
| | | 8357625 | | |
| Canada | — | 302759 | 7152 | 23 |
| Mexico: | | | | |
| Ericsson Co. | 12 | 7889 | — | — |
| Other companies (est.) | — | 8000 | | |
| West Indies (est.) | — | 17000 | — | — |
| Total—North America | | 8693300 | — | — |

## South America.

The telephone system of this continent is entirely in the hands of private companies, and they are numerous. Among the largest are the *River Plate*, the *Monte Video*, and the *Chili* Telephone Companies, and those operating in Brazil. Statistics were obtainable only from the Monte Video Company, which had 5700 stations on its system on January 1st, 1912, and from the Chili Company, which had 11,700. The largest system is that of the River Plate Company which probably operates not less than 40,000 stations. There are



Digitized by Google

also about 10,000 stations in the Argentine on the systems of local companies. In 1909 there were 39 different telephone systems in *Brazil* with 9200 subscribers. Allowing for an increase of about 1000 a year it seems safe to assume that there were at least 13,000 telephones in the Republic at the beginning of 1912.

There are also telephone companies operating in Peru, Ecuador, Venezuela, Paraguay and British Guiana.

A pamphlet issued recently by the American Telephone and Telegraph Company computed the number of stations in South America in 1911 at 85,700. A figure of 88,000 for 1912 will therefore not be excessive.

| | |
|---|---|
| Argentine Republic | 50000 |
| Brazil | 13000 |
| Chili | 11700 |
| Monte Video | 5700 |
| Allowance for rest of Uruguay, Peru, Guiana, Venezuela, Paraguay, Ecuador, etc. | 7600 |
| | 88000 |

With these approximate figures it will serve no useful purpose to give the proportion of telephones to population in South America.

### AUSTRALASIA.

*Australia.*—The figures furnished by the Commonwealth are, as already stated, those for the beginning of 1911. It is, however, possible to arrive at a fairly accurate idea of the present development by basing an estimate on past progress.

| | Beginning of 1910. | Beginning of 1911. | 1912. (est.) |
|---|---|---|---|
| New South Wales | 30892 | 36631 | 42400 |
| Victoria | 21418 | 25350 | 29100 |
| Queensland | 8017 | 9439 | 10800 |
| South Australia | 6179 | 7410 | 8600 |
| Western Australia | 6611 | 7239 | 7800 |
| Tasmania | 2494 | 2737 | 3000 |
| Australia | 75611 | 88860 | 101500 |

The proportion of inhabitants to telephones at the beginning of 1912 was 39 in New South Wales, 37 in Western Australia, 46 in Victoria, 50 in South Australia, 55 in Queensland, or 44 for the whole of Australia.

*New Zealand.*—The total number of telephones in New Zealand (including call-office stations) at March 31st, 1912, was 40,598. Of



Digitized by Google

these, 5055 were in Auckland, 4594 in Wellington, 4106 in Christchurch and 3761 in Dunedin. The average number of inhabitants per telephone was 25.

The number of telephones in Australasia may, therefore, be put at about 142,000.

From the foregoing the total number of telephones in the world may be stated as follows:

| | January 1st, 1912. |
|---|---|
| Europe | 3,153,000 |
| Asia | 205,000 |
| Africa | 36,300 |
| North America | 8,693,300 |
| South America | 88,000 |
| Australasia | 142,000 |
| | 12,318,000 |

## II. The Development of the Great Cities.

Table IV is believed to comprise all the cities in the world containing upwards of 10,000 telephones. The figures shown in italics are estimated, while those marked with an asterisk are made up of official "Bell" figures, to which an estimate of the number of "independent" stations has been added.

Of these cities, which number 102 in all, 69 are in America (64 in the United States), 39 in Europe, 2 in Asia and 2 in Australia. The figures for the British cities include the late National Telephone Company's private wire stations.

### Table IV.

| City. | No. of telephones beginning of 1912. | City. | No. of telephones beginning of 1912. |
|---|---|---|---|
| New York | 441,128 | Cincinnati | 53,594 |
| Chicago | 279,383 | Minneapolis* | 50,270 |
| London (with suburbs) | 220,782 | Copenhagen (and suburbs) | 48,301 |
| Berlin (with Neukölln, Charlottenburg and Wilmersdorf) | 177,854 | Buffalo | 46,951 |
| | | Baltimore | 46,428 |
| | | Washington | 43,972 |
| Philadelphia | 145,535 | Glasgow | 41,310 |
| Boston (Mass.) | 140,153 | Milwaukee | 39,488 |
| San Francisco | 100,523 | Toronto | 38,184 |
| St. Louis | 90,010 | Indianapolis* | 36,000 |
| Los Angeles | 86,922 | Montreal | 35,407 |
| Paris | 84,489 | Buenos Ayres | *35,000* |
| Detroit | 77,866 | St. Petersburg | *35,000* |
| Stockholm | 73,600 | Portland (Oregon) | 34,338 |
| Cleveland | 71,532 | Oakland | 33,794 |
| Pittsburg | 71,249 | Denver | 33,254 |
| Hamburg-Altona | 64,935 | Tokio | 32,557 |
| Kansas City | 57,934 | Moscow | *32,500* |
| Vienna | 54,888 | Seattle | 32,300 |



Digitized by Google

TABLE IV—*continued.*

| City. | No. of telephones beginning of 1912. | City. | No. of telephones beginning of 1912. |
|---|---|---|---|
| Columbus* | 31,700 | Syracuse (N. Y.) | 15,335 |
| St. Paul* | 31,000 | Mexico City | *15,000* |
| Liverpool-Birkenhead | 30,596 | Worcester (Mass.) | 14,932 |
| Omaha | 30,280 | Houston (Texas) | 14,913 |
| Munich | 29,843 | Osaka | 14,630 |
| Manchester | 27,917 | Richmond (Va.) | 14,492 |
| Louisville* | 25,500 | Amsterdam | 14,341 |
| Leipzig | 25,489 | New Haven (Conn.) | 14,288 |
| Warsaw | *25,000* | Springfield (Mass.) | 14,230 |
| Newark (N. J.) | 24,485 | Des Moines (Ia.) | 14,167 |
| Frankfort on Main | 24,403 | Hannover | 13,534 |
| Rochester* | 24,000 | Hartford (Conn.) | 13,475 |
| Providence | 23,739 | Nuremberg | 13,294 |
| Toledo (Ohio) | 23,000 | Edinburgh | 13,243 |
| Grand Rapids | *23,000* | Albany | 12,826 |
| Sydney | *22,000* | Hull | 12,347 |
| Dresden | 21,885 | Gothenburg | 11,983 |
| Spokane | 21,571 | Zürich | 11,956 |
| Buda Pest | 21,388 | Tacoma | 11,827 |
| Cologne | 21,180 | Forth Worth (Texas) | 11,405 |
| Melbourne | *20,500* | Norfolk (Va.) | 11,324 |
| Dallas (Texas) | 19,388 | Dayton (Ohio) | 11,260 |
| Winnipeg | 19,000 | Bremen | 11,056 |
| Salt Lake City | 18,831 | Milan | *11,000* |
| New Orleans | 18,783 | Memphis (Tenn.) | 10,809 |
| Brussels | *18,500* | Nashville (Tenn.) | 10,742 |
| Jersey City | 18,475 | Bradford | 10,467 |
| Atlanta (Ga.) | 17,853 | Newcastle-on-Tyne | 10,245 |
| Stuttgart | 17,782 | Sheffield | 10,114 |
| Christiania (June 30th, 1911) | 17,361 | Leeds | 10,092 |
| Breslau | 16,839 | Duluth | 10,008 |
| Birmingham | 16,529 | St. Joseph (Mo.) | 10,003 |
| Düsseldorf | 15,642 | Rome | *10,000* |

The following are the ten best developed cities in the world. They are all American except Stockholm.

TABLE V.

| | Telephones. | Population. | Population per telephone. |
|---|---|---|---|
| 1. Los Angeles | 86,922 | 356,000 | 4·1 |
| 2. San Francisco | 100,523 | 429,000 | 4·2 |
| 3. Stockholm | 73,600 | 342,000 | 4·6 |
| 4. Omaha | 30,280 | 162,000 | 5·3 |
| 5. Spokane | 21,571 | 116,300 | 5·4 |
| 6. Salt Lake City | 18,830 | 104,100 | 5·5 |
| 7. Dallas | 19,388 | 116,200 | 6 |
| 8. Des Moines | 14,167 | 90,100 | 6·4 |
| 9. Houston | 14,913 | 95,000 | 6·5 |
| 10. Portland (Oregon) | 34,338 | 228,000 | 6·6 |

The following table shows the telephonic development of the principal cities of the world with upwards of 1,000,000 inhabitants.



Digitized by Google

TABLE VI.

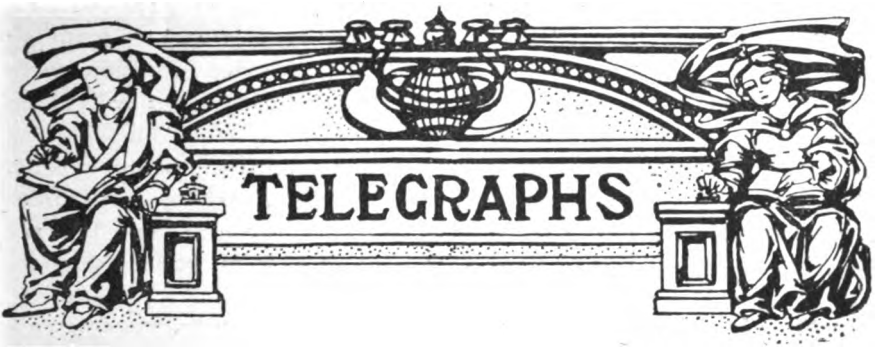
| | Telephones. | Population (thousands) | Population per telephone. |
|---|---|---|---|
| Chicago | 279,383 | 2264 | 8·1 |
| Boston | 140,153 | 1389 | 9·9 |
| Philadelphia | 145,535 | 1592 | 10·1 |
| New York | 441,128 | 4994 | 11·3 |
| Berlin | 133,867 | 2296 | 17·1 |
| London | 220,782 | 7160 | 32·5 |
| Paris | 84,489 | 2846 | 33·7 |
| Buenos Ayres* | 30,844 | 1190 | 38·6 |
| Vienna | 54,888 | 2085 | 38 |
| Moscow (est.) | 32,500 | 1359 | 41·8 |
| St. Petersburg (est.) | 35,000 | 1678 | 48 |
| Tokio | 32,557 | 2186 | 67 |

* Last year's figures.

It would be vain within the limits of a short statistical paper to attempt to discuss the inevitable comparisons which the disparities in development shown in the foregoing figures suggest. Much has been said of the position occupied by this country, and references have been made to Sweden and the United States which have long since lost the charm of novelty without gaining in instructiveness. The complex causes of the arrested development of Great Britain are well known to our readers and need not be enlarged on here, but while admitting this it may be pointed out that the comparisons so frequently drawn with other countries are almost invariably uncritical. Without the existence of like conditions there can be no useful comparison. The value of money, the cost of labour and materials, the density of population, the state of internal communication, and the development of the telegraph and railway systems vary as between this country and America, and as between both and Scandinavia. Again, we hear much of cheap rural co-operative telephone systems with a rough and ready kind of plant, but it may be doubted if such would be accepted by subscribers in Great Britain, who demand a standard service for their subscriptions. When, however, we compare this country with the great states of Western Europe, where a certain similarity of conditions obtains, we find that our development is but little behind that of Germany, and is immeasurably superior to that of France, Austria, and Italy, to say nothing of such commercial countries as Holland and Belgium. Moreover, it must be remembered that the high development of one or two European countries has been obtained at notoriously unremunerative rates—a result which is not desirable from an economic standpoint.



Digitized by Google




# AN AUSTRALIAN RELAY STATION, AND EARTH CURRENT OBSERVATIONS THEREAT.

By S. J. Willcox.

During the period I was a telegraphist in the home service at Bristol my experience of earth currents was confined to noticing a slight bias on the galvanometers, and hearing the testing officer remark, "Earth currents are on the lines." Now, after sixteen years in Australia, I can only remember seeing earth currents affect telegraph circuits in any pronounced degree on one occasion. But as on this occasion I had the opportunity of witnessing a magnificent display of the Aurora Australis, and its effect on very long telegraph lines at an isolated telegraph repeating station, a short account of this magnetic storm may be of some interest to those who closely follow this subject.

Before describing the occurrence, however, a short description of the "out of the world" station in Western Australia where I was stationed may not be out of place. It bears the name of Eucla, a native name having reference to some wells in the vicinity. The station appears on all maps of Australia, and is close to the boundary line dividing Western from South Australia, but very little is known of it even by the average Australian. To be exact it is eight miles west of the South Australian border, and is nearly at the head of the Great Australian Bight. Our nearest neighbours were about 250 miles away to the east (Fowler's Bay) and the nearest township west over 600 miles. Northward no human habitation existed for 2000 miles, whilst to the south, our nearest neighbours would be any Antarctic explorers bent upon reaching the South Pole. During my three years' sojourn there I often thought of the utter isolation of our station in vivid contrast with the narrow crowded streets of Bristol, through which I used to rush to the office; yet I was never happier or in better health in my life than at Eucla.



Digitized by Google

Once a month we received our letters, which were carried by a little two-horse buggy from Fowler's Bay, the journey up occupying seven days. Nothing grew locally, and hence our provisions were brought by steamer from Albany, W.A. (800 miles), once every three months.

Line inspections to the westward were carried out on camels. Our section was 120 miles in length, and the energy of our old lineman, 60 years of age, who left England as a boy, and spent the rest of his life on the coast between Adelaide and Eucla, was remarkable.

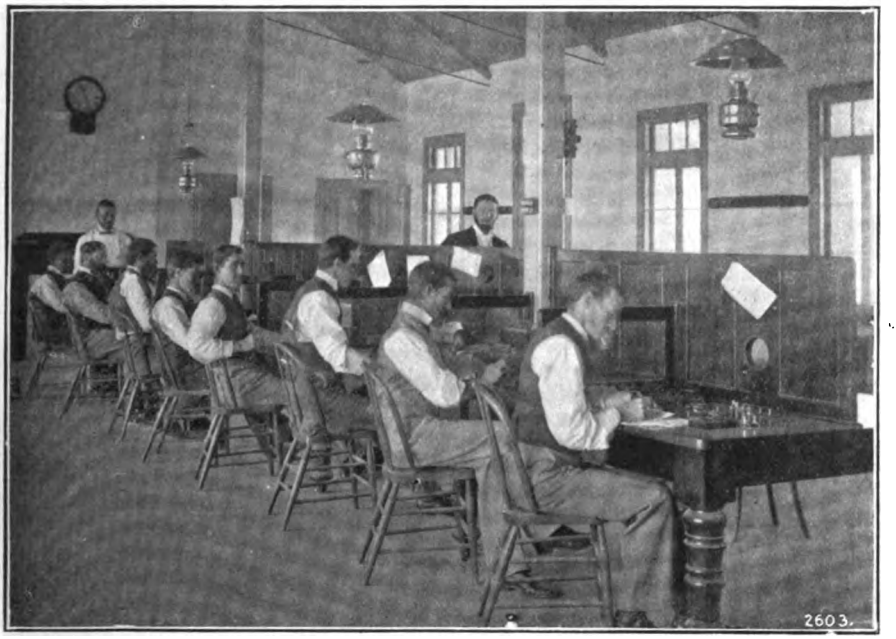
I.—EUCLA. A WESTERN AUSTRALIA RELAY STATION SIX HUNDRED MILES FROM NEAREST TOWN.

We would inform him at 7 a.m. that the lines were crossed about eighty miles out; and an hour later he would have packed a few tins of sardines and salmon, 20 lb. of flour, a couple of loaves, and some tea, and disappeared on his journey of eight or ten days without telling anyone he was going, or even considering such a trifle necessitated saying "Good morning," and yet on these trips he would rarely see a human being. The faults themselves were often of a type different from those met with in the old country. Two lines were carried on iron poles without cross-arms, and the most common fault on these were crosses made by wild turkeys flying between the wires. It was the usual thing to find a dead turkey or



Digitized by Google

some of its feathers underneath the fault. The other line was carried on wooden poles and followed the coast, and all sorts of trouble occurred on it. The white ant makes a hearty meal inside the pole, then a stray camel thoughtfully uses it as a scratching post (no trees being in the vicinity), and the voracious attack of the ant followed by the vigorous rubbing of the camel combine to lay the pole in the sand. Another curious fault is the earth leakage, which follows a prolonged spell of fine weather. The insulators get encrusted with a film of salt, which when the wind veers south becomes moist, and the result is practically a dead earth. But with




2.—INTERIOR OF EUCLA RELAY STATION WHEN REPEATING WAS DONE MANUALLY.

the first good shower of rain the insulators are washed, and lo, "the line is perfect."

The rainfall is, however, very scanty, averaging about seven or eight inches a year, and we conserved our roof catchments in large underground tanks. This catchment, with economy, was generally sufficient, but on a few occasions it was necessary to condense a certain amount of salt water and put the station on an allowance.

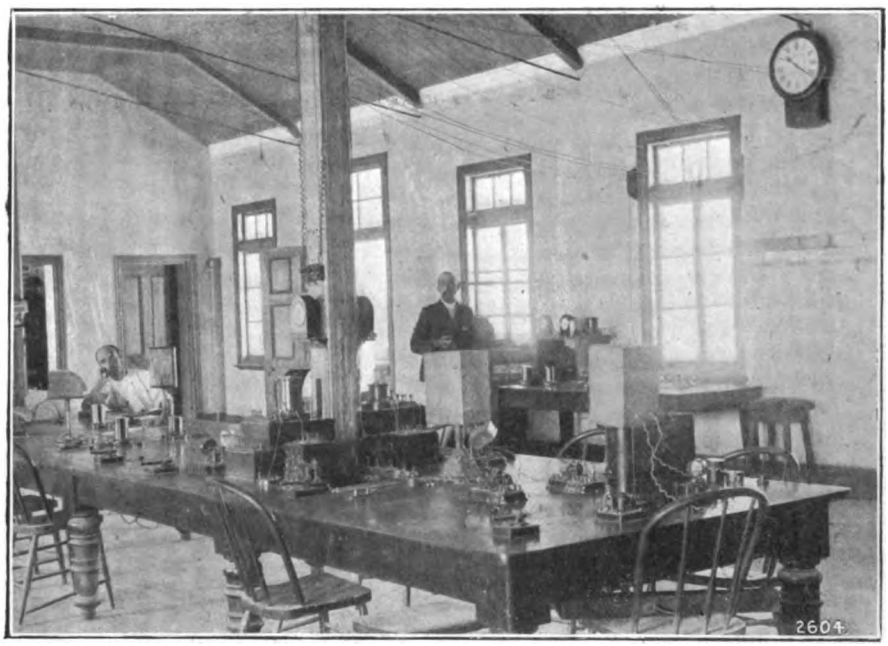
Fortunately we were close to the ocean, or I think life would have been unbearably monotonous, but a walk along the beach, watching the breakers roll in from the southern ocean, refreshed one, and was a welcome change to the monotony of the everlasting clicking of the instruments at the office.



Digitized by Google

The strenuous life inside the office was very different to the deadly quietude outside. One wide table ran nearly the length of the room, one side being styled the S.A. and the other the W.A. side. On each side was fitted one quadruplex and two duplex circuits, so that the office when fully manned required sixteen men.

Plain paper cut to size sufficed for telegraph forms, as the messages were taken on one side of the table and simply passed over to the other. We had two different times, and when the S.A. clock stood at 10 a.m. the W.A. would be 8.30, which made delays rather




3.—Interior of Eucla Relay Station after Introduction of Automatic Repeaters.

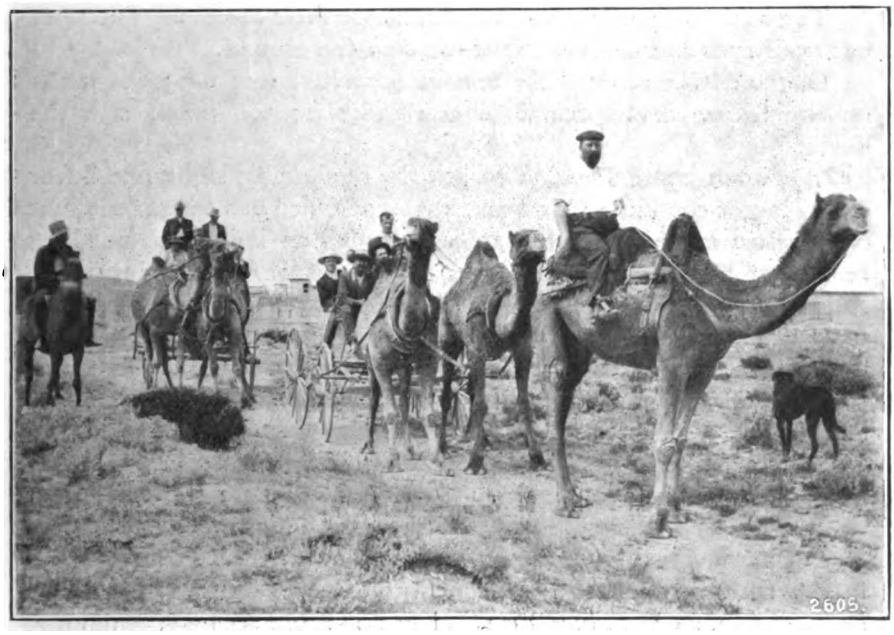
difficult to check, as a message received at 8.30 and sent on at 10.1 would only carry one minute's delay. But there were no engineers or inspectors to pay surprise visits. They could not possibly reach us unless we had a week's notice to prepare!

Every message between Western Australia and the Eastern States passed through this office, and our daily average was over 2000 messages, equal to 4000 transmissions per day. The staff consisted of twenty-eight telegraphists, supervisor and postmaster. A few members of the staff had their wives and families there, making a total of about fifty on the station. The nearest doctor was over 500 miles away, and, considering that we had to live largely on tinned food, the fact that we had very little sickness speaks well for the



Digitized by Google

climate. The family doctor was the magnesia cask in the battery room. The climate generally is ideal, and both in summer and winter we got weeks of cloudless skies. Sometimes in the summer a strong north wind would blow, and then the thermometers would "bolt" and run up to 116° F. in the shade. The highest I experienced, and I believe the record for the station, was 122·8° F. in the shade and 175·2° F. in the sun. This was "pitching it high" certainly, and to celebrate it some of us pretended not to feel it and played tennis. It is such a dry heat, however, that it does not feel so bad as it looks. A cool southerly wind invariably followed the




4.—The Eucla Staff enjoying a Picnic.

hot blast from the north, and in an hour the temperature would drop nearly fifty degrees. Eucla was an important weather station, and the records were carefully taken under proper shade screens. Our recreation consisted of rifle shooting, tennis and cricket. The fishing was poor and the boating dangerous. The Government supplied us with an up-to-date billiard-room and table, and that brings me back to the subject from which I have wandered.

It was about 9.30 one Saturday night, when all traffic was clear, and one line had been put through repeaters so that Perth worked direct to Adelaide (2000 miles), and only one officer remained on duty. Two of us were playing billiards, and during the game we heard loud shouts coming from the niggers' camp, about half a mile



Digitized by Google

away. My friend suggested that we should walk down, but as it was a moonlight night, and I knew the niggers were partial to moonlight nights for some of their mystic ceremonies, I did not think it worth while. Just then the officer on duty came to me and reported that the lines "looked crook" on both sides, so we went to the office. On our way we saw shooting up from the Southern Ocean long bands of sulphurous smoke. They shot up, leaving tracks like a rocket, and when overhead exploded in large yellow-tinted puffs, which gradually disappeared towards the northward. The splendour of the sight, had the night been a moonless one, is scarcely conceivable; even with the bright moon it was most wonderful.

The natives were very frightened, hence their shrieks. They put out their fires and lay with their faces on the ground.

One old Gin said: "Me mucka (nothing) like um; too much cheeky fellow debbil debbil (I don't like it; too much like the devil!").

We woke up the station to see the remarkable sight, and I fear we all forgot the lines for a time, but experience has taught me that it is useless worrying when Nature is having an innings on our long lines. At the height of the atmospheric display I got Perth and Adelaide to "dis." the lines, and both sides were clear. I then got them to earth, and I did ditto and watched the effect. It was most marked. The currents came on increasing in strength exactly coincident with the long fingers of bright yellow smoke which shot up into the sky and disappeared.

Both galvanometers were biased to the zinc, or spacing side, to the extent of quite 45 ma.'s. I did not measure the current at the time, but I knew the value of the differential galvos deflection. The currents did not remain on long, but rose from zero to 45 ma.'s in about five seconds, then remained at that strength approximately another five, and gradually cleared in about ten seconds, remaining clear till the next discharge.

Work, of course, was impossible, but as there was none about we just watched the sky and noted the effect on the instruments.

This display lasted for about an hour, and during this time nothing exceptional was visible on the southern horizon, but as the puffs of yellow vapour ceased the horizon commenced to assume a most wonderful hue. I have seen nothing like it either before or since, and can only liken the colours and blending to pictures I have seen of the midnight sun, or the very gaudily painted pictures one occasionally sees of sunrise or sunset. It looked like the tints one would expect to see reflected from some huge iron blasting furnace.

It was too fascinating a sight to leave for bed, but as it showed no sign of change at 2 a.m. I turned in, but looked out again just



Digitized by Google

before dawn, when it was still visible but getting lighter. During the latter stage of the display a steady bias of about 5 ma.'s appeared on the galvanometers, through which we worked without difficulty. The current gradually disappeared as dawn broke. I cannot fix the date with precision now, but it was, I believe, in 1909; I remember, however, that when the cable press came through the next day it contained the news that severe magnetic storms had been experienced in North America and Northern Europe, seriously interfering with the telegraph services.

I might add that the glory of Eucla has now departed. A Wheatstone repeater has replaced the hand repeating quadruplex, while the two-hand duplex circuits are put direct through P.O. standard relay repeaters. Only five officers are now employed there as repeater clerks, and I fear that for these the life must be even quieter than it was during the three years I acted as supervisor of the station.

---

## THE MORKRUM PRINTING TELEGRAPH.

By DONALD MURRAY, M.A., M.I.E.E.

FOR more than thirty years one of the chief hobbies of American inventors has been printing telegraphy. The earliest practical result was the development of stock-tickers, which reached maturity many years ago. With this exception, however, it is only within comparatively recent years in America that inventive work on printing telegraphy has been established on a really practical basis. In the United States there has been a parallel development along the same three lines as in Europe, namely (1) automatic, (2) multiplex, (3) direct keyboard transmission, usually duplex. The automatic systems have not found much favour in America. The Buckingham-Barclay used by the Western Union on about sixty circuits is the best known American automatic system. The Rowland is the most prominent multiplex system. Although there are no multiplex printing telegraphs at present in use in the United States, there are one or two promising systems being developed, including the Murray multiplex, the American rights to which have been purchased by the Western Union Company.

The third class of printing telegraphs, corresponding to the Hughes in Europe, has been a special favourite with American inventors. Their attention has been devoted largely to the idea of two typewriters, one at each end of a telegraph line, each able to operate the other over a single wire. To secure a practically free typewriter keyboard so that the keys may be struck rapidly and



Digitized by Google

without any cadence, the carrying capacity of the line is sacrificed by raising the speed of transmission to 70 or 80 words per minute, though the actual output on such systems working duplex is on the average only about 30 words a minute each way. The saving lies in the cheap and comparatively unskilled labour that may be employed. There are a very large number of telegraph circuits which have not sufficient traffic to require more than one transmission at moderate speed each way. For such circuits automatic or multiplex printing telegraph systems with a high message-carrying capacity are needlessly expensive. At present such circuits are worked simplex or duplex with the Morse key and sounder, or with the Hughes. Of course a considerable portion of this class of traffic will ultimately be handled by the telephone, but for dealing with a large part of it a printing telegraph on the lines just mentioned would appear to have decided advantages. Quite a number of printing telegraphs of this kind have been invented in America, but so far only one or two have reached the stage of practical utility. Up to the present the most successful printing telegraph of this class is what is known as the Morkrum.

The Morkrum printing telegraph may be described as a direct transmitting free typewriter keyboard system giving one transmission in each direction by means of the duplex balance. It is not a multiplex system, and its value appears to be on circuits carrying from 400 to 1000 messages per day. It was invented by Mr. Charles L. Krum, a Chicago cold-storage engineer, assisted by his son, Mr. Howard L. Krum, and it is being financed by Mr. Joy Morton, a Chicago millionaire. The development of the system has taken from 12 to 14 years, and it is now in very good shape. During a trip to New York and Chicago about the beginning of the present year I took the opportunity of carefully inspecting and studying the system. I found it to be well made and designed. It has a free typewriter keyboard and uses pure alternating current. The Baudot alphabet is employed with an extra positive starting impulse. Only the good central portion of each signal is utilised, as in the Baudot and the Murray multiplex. The system is page-printing, and there is a "home recorder," on which the sending operator can see what he is doing. The system is built up in instantly interchangeable units, so that interruptions of work are quickly cleared by inserting duplicate units. There is no synchronism or isochronism except during the short interval required for the transmission of one letter.

I was informed in Chicago that the Morkrum system working duplex easily exchanges on the average 800 American messages on one wire in a day of nine hours. This information was confirmed by the results obtained by the telegraph companies in New York. These results are with one girl operator sending and one girl



Digitized by Google

receiving at each end of the line. During one week at the Postal Telegraph Company's office the average throughout the week was 988 messages per day of nine hours. The Postal Telegraph Company has eight Morkrum circuits in use on lines averaging about 300 miles in length, the longest being on a New York-Chicago wire, 1000 miles, with one repeater half way. The Western Union Company has six duplex circuits fitted with the Morkrum between New York and Philadelphia, 90 miles. Several circuits belonging to various railroads in the United States are equipped with the Morkrum, and two installations are in use by the Canadian Pacific Railroad Company on two wires between Montreal and Toronto.

1.—KEYBOARD AND HOME RECORDER.

The following are the latest records achieved by the Morkrum system; 1207 messages (655 one way and 552 the other) were exchanged in one day of nine hours on the Chicago—St. Louis circuit (300 miles). A girl operator in Boston on the New York-Boston Morkrum circuit (250 miles) sent 745 messages in nine hours, and in one hour she sent 104 messages.

In view of these excellent results, the following technical outline of the system will no doubt be read with interest.

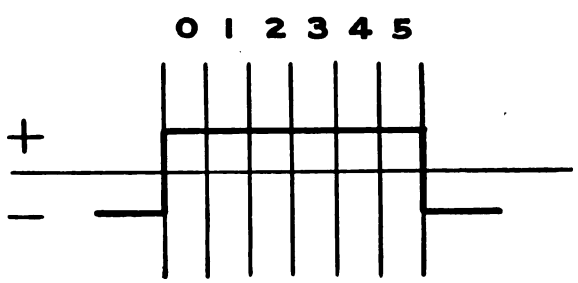
The main part of the Morkrum is shown in 1. This is the keyboard transmitter and the printer combined in one instrument, or more strictly the printer placed on top of the keyboard. In addition to this machine there are several banks of relays, and a small motor-driven machine, which may be described as a single-



Digitized by Google

revolution distributor. That is to say, every time a key is depressed a contact arm with a brush makes a single revolution round the commutator, thereby transmitting the elements of the letter successively into the line. When transmitting on the keyboard shown in 1 the printer is operated by a local relay controlled by the outgoing signals so that the operator can see in front of him the exact record of what he is sending—in other words, the printer serves as a "home recorder." A separate printer of exactly the same design prints the messages transmitted from the distant station. The home recording printer, being interchangeable with the other printer, serves as a reserve printer, the home record not being absolutely necessary, or at least it can be spared for a little while during emergency.

The Baudot alphabet is used, but a positive starting impulse




2.

precedes the five selective impulses. The current is of single strength with the battery always connected to the line, and the signals are transmitted by reversals of polarity. The transmitted signal is divided into six time intervals. The negative pole of the battery is normally connected to the line between signals, and it is accordingly essential that a signal be started by connecting the positive pole to the line.

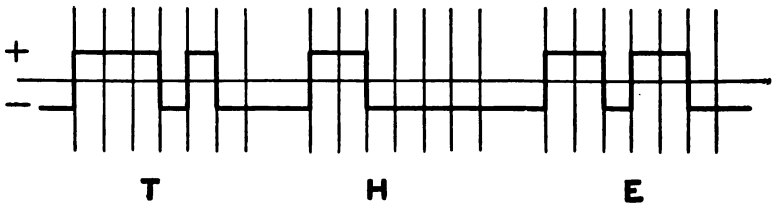
2 shows a signal in which current of positive polarity is sent to the line during all of the six time intervals. The first interval is designated as O in the diagram, and is known as the starting interval. The selective signalling is accomplished by combinations of reversals of polarity of the current sent to the line during the five succeeding time intervals. This allows thirty-two selections to be made over the line, and by using a shift of the type wheel, fifty-three letters, figures and characters are printed.

This system of selective signalling is illustrated in 3, which shows the signals sent over the line for the word "The." The letter "T" is formed by reversing the polarity of the current sent to the line



Digitized by Google

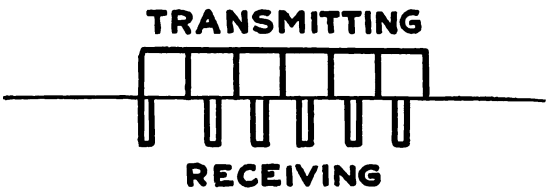
during the third and fifth intervals. In letter "H" the current is reversed during the second, third, fourth and fifth intervals, while in letter "E" the reversal takes place during the second and fifth intervals. As in this system there are never more than three and an average of only two signalling currents sent to the line for each letter, it is not necessary to transmit the signals at a high rate of speed in order to obtain the necessary speed on the transmitting keyboard.




3.

4 shows the theory of the action of the receiver in selecting the different signals. The receiving mechanism is arranged to connect the selective locks to the line relay for only a short portion of the duration of each time interval of the transmitting signal—that is to say, the receiving mechanism is operated only by the good central portion of the signals.

The system is not synchronous in the ordinary sense of the word, but is roughly isochronous—that is to say, the receiving




4.

mechanism is adjusted to run at approximately the same speed as the transmitting mechanism, and a governing rheostat is provided to regulate the speed of the receiving mechanism, so that the relation of the received intervals to the transmitted intervals can be correctly adjusted.

This arrangement allows of considerable distortion of the signals before the selection is interfered with, as it is only necessary that the interval of the receiving mechanism shall lie somewhere within the limits of the corresponding transmitted signal.



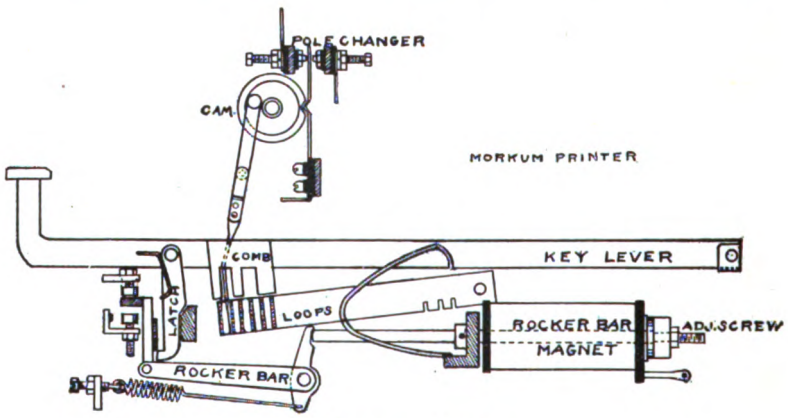
Digitized by Google

The signals are set up on a keyboard containing five cam-operated pole-changers and are transmitted to the line by means of a commutator and brush controlled by a single-revolution clutch and pawl.

The selection of the letter at the receiving station is accomplished by means of a bank of relays, which are put in operation by the positive starting impulse, and which distribute the incoming signal to five selective locks, which in turn control the local operations of the printer.

The keyboard contains five pole-changers, which control the polarity of the current sent to the line during the five selective time intervals, and one operating cam which controls the rocker bar and transmitter clutch.

These pole-changers are operated by cams attached to the




5.—KEYBOARD ACTION.

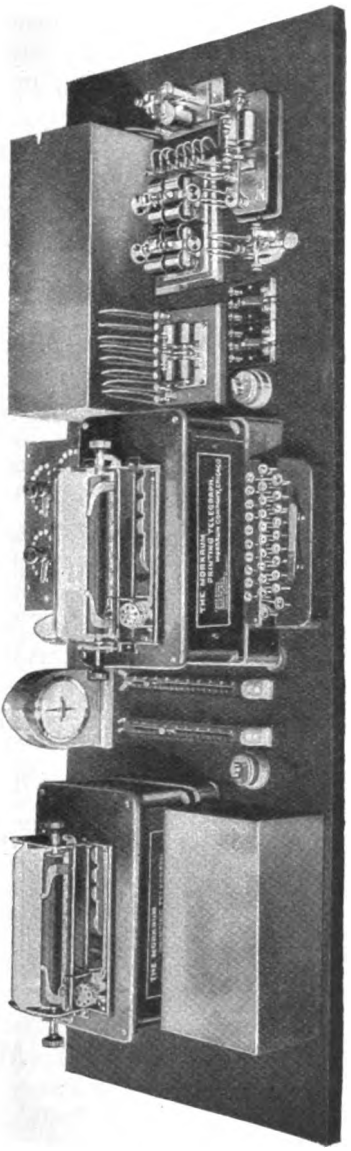
loops which extend across the keyboard underneath the key levers, as shown in 5, and each key lever has on it a comb which operates the proper combination of loops and pole-changers for that particular key. The operating cam is worked by all key-bars. The depression of a key throws the latch under the rocker bar; the operating cam then closes the circuit to the rocker-bar magnet and trips the clutch, allowing the brush to make a single revolution. The rocker bar pulls down the key lever and holds it down until the transmission of the signal is completed. The operation of the rocker bar and latches makes it impossible to depress another key lever until the preceding signal has been completed.

The transmitter consists of a motor driving a shaft at a constant speed which is regulated by means of an electric governor. The governor is of the ball and link type, and is arranged to operate a contact which inserts a resistance in the motor circuit when it



Digitized by Google

reaches a given speed. A fly-wheel on the motor prevents sudden fluctuations of speed. Mounted on the driving shaft is a ratchet. The brush arms are mounted on a hollow sleeve, and a clutch



6.—Top of Duplex Table.

pawl is arranged so that when the trip mechanism is operated it will engage the ratchet wheel and cause the brush arms to make one revolution. A cam-operated contact mounted between the brush arms controls the rocker-bar magnet in the keyboard, and



Digitized by Google

ensures the holding down of the key until the revolution of the brush arms is complete.

The printer is of the intermittently rotating type-wheel class. Following the example of most column printing stock tickers the type mechanism moves and the platen is stationary. This is an advantage in feeding in cut message forms, and it is also an advantage in printing on a roll, as the spacing mechanism does not have to move a heavy roll of paper.

The selecting mechanism consists of four movable plates interposed in the path of a series of stop pins. Holes are so arranged in the plates that in any setting a free opening will be formed opposite two of the stop pins. These pins then form the stop for an index lever which is geared to the type wheel and thus locates the type wheel opposite the desired letter.

The operation of the printer in printing a letter consist of the following steps:

First, the setting of the four plates of the selecting mechanism. This is governed by the first four intervals of the signal. In any setting of the plates the openings in the plates are lined up opposite two of the pins in the drum barrel.

Second, the operation of the drum barrel, which forces all the pins against the plates. The two pins opposite the lined holes in the plates pass through while all the rest are blocked.

Third, the rotation of the type wheel. The direction of rotation is governed by the polarity of the last interval of the signal. An arm on the rotator shaft is stopped by the pin previously selected, and stops the type wheel opposite the letter corresponding to the received signal.

Fourth, after the rotation of the type wheel it is thrown forward against the paper to print the selected letter. An arm on the striker shaft operates the main break and unlocks all the printer circuits in readiness for the next letter.

**6** is a general view of a table fitted with a complete duplex installation of the Morkrum system.

---

## REGULATION OF WIRES BY MEANS OF BEAMS.

By G. M. Carr, M.I.E.E.

Shortly after the issue of the tension ratchet or stress meter in its present familiar form, experience showed that it did not quite fulfil all that was said for it. Owing to slight differences, the same stress does not always produce the same indications on different

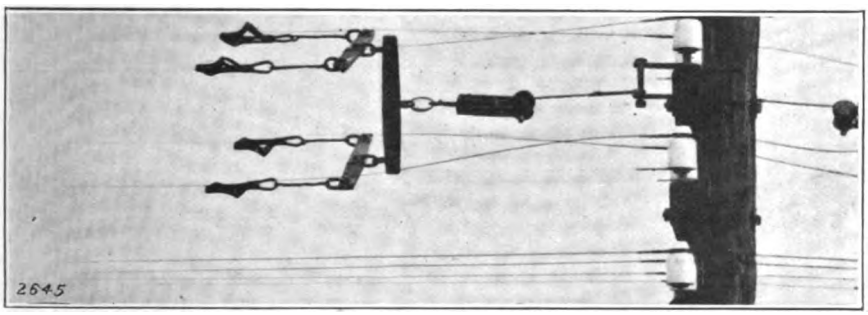


Digitized by Google

meters. Moreover, dependent on the amount of wire on the drum of the meter, the same number of notches does not always represent the same shortening or lengthening of the wire. To these disabilities we must add the friction of the wire as it passes around slight curves or across the top surface of the arm, so that when low tensions are required,good regulation is by no means easy of accomplishment.

As a consequence, in practice, the meter is used for setting one wire to the desired standard and drawing the other to the same dip, the result being dependent on the skill of the foreman. Happily, many foremen can do this with considerable accuracy and finish, but there are also many to whom this is a difficult task and unsatisfactory work is a consequence.

In studying the problem with a view to better results it occurred to me to attempt to draw up two wires at the same time and in such a way that the tension of one should balance that of the other.




I.—One Pair of Beams Balancing Four Wires.

To do this, I employed a rimmed wheel—as a matter of fact, a small perambulator wheel minus the rubber tyre. Around the groove a strong cord was passed and on each end of this was fixed a small tongs, and in each tongs a wire was gripped. The stress meter was then attached to the fork holding the wheel, which, being free to move, immediately assumed a position of equilibrium, thereby producing equal stress and dip on each wire. Of course, the total stress thus indicated on the meter was that of two wires instead of one.

It was soon found that equally good results could be obtained by means of a wooden beam about 14 inches long similar to a scale beam, each end representing the periphery of the wheel whilst the centre had a suitable fork or loop on which the beam could move freely. It was then a very natural step to pass from two wires to four on the same principle. One beam was used for two wires, one wire balancing the other, and another beam with other two wires similarly balanced, and a third beam to each end of which were attached the respective beams each carrying two pairs (see 1).

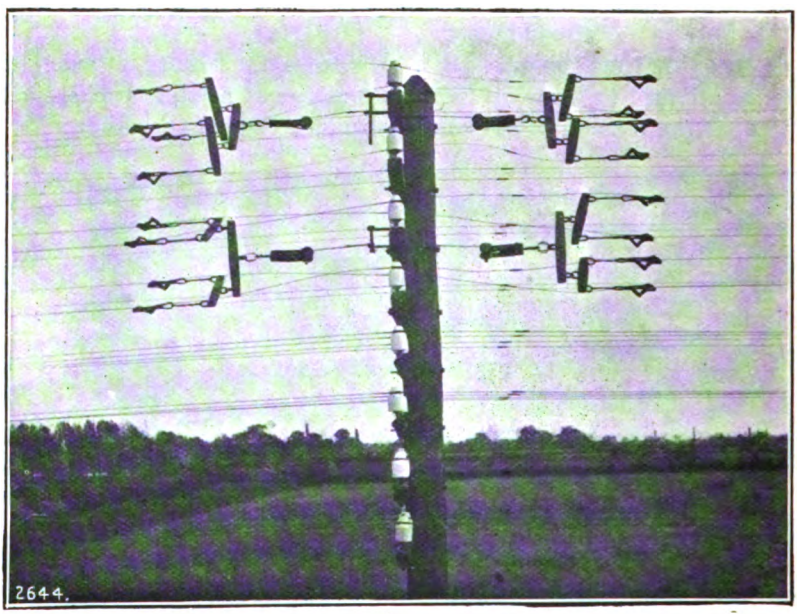


Digitized by Google

The stress meter was attached to the third beam and obviously the stress on the meter was now four times that of one.

It will be seen that the adjustment of the wires was no longer the direct function of the stress meter. It showed the total stress, which, divided by four, gave the stress for each wire, whilst the regulation of the wires was an automatic result of the appliance.

Of course this did not overcome the trouble caused by friction over the arms, etc.; this had to be met by other means, but in addition to obtaining a very correct balance, any error due to differ-




**2.**—Drawing up Pole with Wires ready for finishing.

ences in the stress metres was confined to a quad of four wires instead of each wire.

At the time of which I am writing, say, twenty-two or twenty-three years ago, great stress was laid on the importance of slack wires in order to increase the margin of safety, and the friction referred to caused a good deal of trouble. To minimise this pulleys were used. These were hung in a suitable casting, and by means of a thumb-screw secured on the neck of the insulators. The pulley was hinged, so that whilst on straight lines it hung close by the side of the insulator, and where a curve existed the pulley fell into the resultant line of the pull of the wire.

By this means many miles of the first four back-bone trunks of



Digitized by Google

600 lb. gauge passing through the Northern District were erected with very gratifying results.

Some years later I introduced the appliance in the North-Eastern District, and many lines carrying large numbers of wires were regulated by this means. The result was most marked. In the latter-named operations the pulleys were dispensed with as the wires were drawn tighter to avoid the numerous contacts, which were a source of continual trouble and loss. All the well-known advantages of good regulation of twisted wires were thus secured by minimum effort.

A good deal of prejudice had to be overcome. By many the process was judged to be slow, but it can be clearly demonstrated that extra trouble is more apparent than real. Invariably the labour in preliminaries is much more than compensated by the ease with which the later part of the work was accomplished, to say nothing of the superior result.

The illustration (**2**) shows a drawing-up pole with the wires ready for finishing. It is scarcely necessary to say that the wires may be just as easily dealt with in one direction as in two, if desired.

---

## RENEWAL OF A NUMBER OF CABLES IN THE SAME DUCT.

By J. W. Barber.

Most telegraph and telephone engineers will have experienced the difficulty of pulling one lead cable over another lead cable, which in some measure is due to the adhesion of lead to lead, but it sometimes happens in the course of pulling in that one cable encircles the other, due to the path the "needle" or draw-wire has taken, and when this occurs the trouble is much aggravated.

I had a case of the last-mentioned trouble at Hull, and it may be of interest and assistance to describe the means which were successfully adopted to overcome it.

All the main telegraph and trunk cables have to cross one of the docks to get to the Head Post Office. A vertical shaft, 30 ft. deep and 6 ft. in diameter, exists on each side of the dock, and these are connected across the dock entrance by two 9 in. C.I. pipes said to have been used originally as gas mains. One pipe took the telegraphs and the other the trunks, both containing G.P. quads, and there were sufficient "spares" in the telegraphs to enable the trunk pipe to be cleared. This was done, and a strong sash-line drawn into the pipe as the cables were withdrawn.



Digitized by Google

The sash-line was then made "endless" and strained tightly over blocks fixed on derricks over each of the shafts. The effect of this, it will be seen, was to keep the sash-line at the top of the pipe; then the end of the pulling-in rope was attached to the sash-line and hand-hauled across the dock. The pulling-in rope was next detached from the sash-line and the cable pulled in in the ordinary way, the operation being repeated for each cable.

By this means any threading of one cable through another was

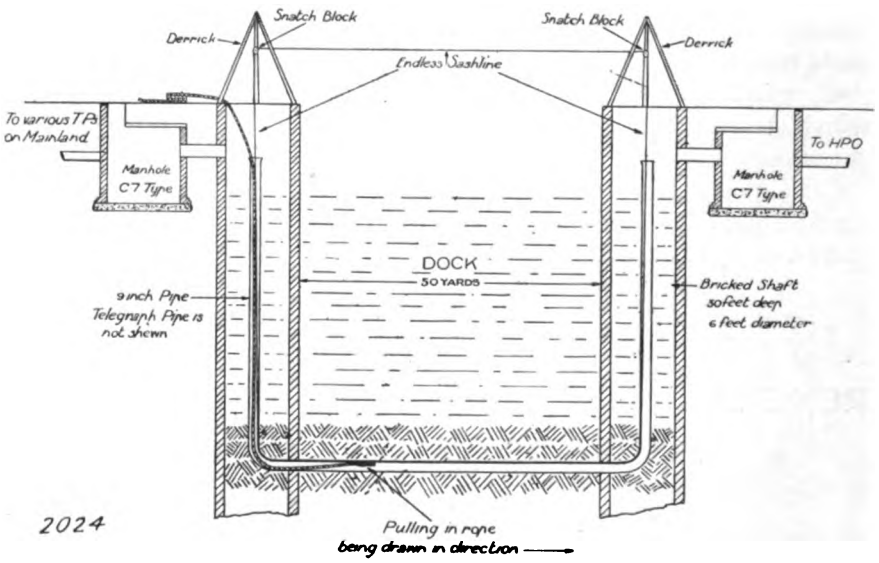



ILLUSTRATION OF A METHOD ADOPTED IN THE RENEWAL OF CABLES IN SAME DUCT. (SKETCH NOT TO SCALE.)

prevented, the pulling-in rope always being clear of the cables previously drawn in.

The accompanying sketch illustrates the conditions which obtained, and indicates the methods adopted to surmount the difficulty.

Fourteen 7-pr. 20-lb. cables and one 600-pr. 10-lb. cable were drawn in by the means stated, after an attempt made to draw in fourteen 7-pr. 20-lb. cables in the ordinary way had been unsuccessful.



Digitized by Google

# ALTERNATING CURRENT CALCULATIONS.

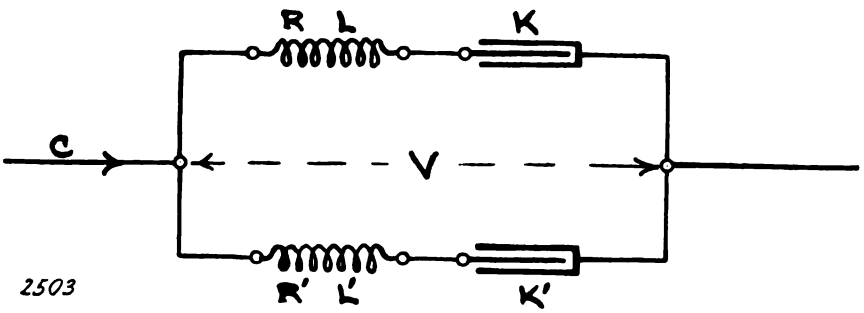
By F. ADDEY, B.Sc., A.M.I.E.E.

(*Continued from p.* 56.)

SUPPOSE now we have to deal with the question of current flow in any arrangement of conductors whatever. We shall have the relation between the instantaneous current $C$ in any branch and the instantaneous difference of potential $V$ between the ends of that branch given by the equation—

$$C = \frac{V}{R + L\theta + \frac{1}{K\theta}},$$

where $R$, $L$ and $K$ are the values of the electrical constants of the branch under consideration. It therefore follows that the laws for




3.—TWO CIRCUITS, HAVING RESISTANCE, INDUCTANCE, AND CAPACITY IN PARALLEL.

the flow of continuous current in such circuits, which are based on the law $C = \frac{V}{R}$, will also hold good for the variable current case, if for the ohmic resistance of each branch we write its impedance operator, $R + L\theta + \frac{1}{K\theta}$.

Thus, suppose we have two paths in parallel, as shown in 3. For the upper path we have $R + L\theta + \frac{1}{K\theta}$, and for the lower path we have $R^1 + L^1\theta + \frac{1}{K^1\theta}$. By what has just been said, using the ordinary law of resistances in parallel, we have the current through the combination given by the equation—

$$C = \frac{V}{\frac{\left(R + L\theta + \frac{1}{K\theta}\right)\left(R^1 + L^1\theta + \frac{1}{K^1\theta}\right)}{R + L\theta + \frac{1}{K\theta} + R^1 + L^1\theta + \frac{1}{K^1\theta}}}.$$



Digitized by Google

This may be simplified, treating $\theta$ exactly as an algebraical quantity. We thus obtain—

$$C = \left[\frac{(K + K^1)\theta + (RKK^1 + R^1K^1K)\theta^2 + (LKK^1 + L^1K^1K)\theta^3}{1 + (RK + R^1K^1)\theta + (LK + L^1K^1 + RR^1KK^1)\theta^2 + (RKL^1K^1 + R^1K^1LK)\theta^3 + LKL^1K^1\theta^4}\right]V.$$

We have thus reduced our expression to the form—

$$C = \left(\frac{a + b\theta + c\theta^2 + d\theta^3 + e\theta^4 + f\theta^5 + \ldots}{a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5 + \ldots}\right)V,$$

where $a$, $b$, $a^1$, $b^1$, etc., are terms involving the electrical constants of the circuit.

No matter how complicated the circuit with which we are dealing may be, we can always reduce our expression to this form.

So far our work has been perfectly general. Our further progress, however, depends on the particular manner in which the voltage varies.

In alternating current work we are concerned with voltages which vary periodically. By Fourier's theorem such periodical variations can always be split up into a number of simple harmonic variations, and the effects of each of these component simple harmonic variations considered separately.

We have therefore to consider the case where the voltage varies according to the law—

$$V = V_o \sin wt,$$

where $w$ is written for $2\pi n$, $n$ being the frequency.

Thus we have to solve the equation—

$$C = \left(\frac{a + b\theta + c\theta^2 + d\theta^3 + e\theta^4 + f\theta^5 + \ldots}{a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5 + \ldots}\right) V_o \sin wt.$$

We have here a direct operation to be performed on $V_o \sin wt$, represented by the numerator of the fraction, and an inverse operation represented by the denominator of the fraction. We will consider these two operations separately.

The result of the direct operation—

$$(a + b\theta + c\theta^2 + d\theta^3 + e\theta^4 + f\theta^5 + \ldots)$$

on $V_o \sin wt$ is the same as—

$$\left(a + b\frac{d}{dt} + c\frac{d^2}{dt^2} + d\frac{d^3}{dt^3} + e\frac{d^4}{dt^4} + f\frac{d^5}{dt^5} + \ldots\right) V_o \sin wt,$$

which is equal to—

$$aV_o \sin wt + bwV_o \cos wt - cw^2V_o \sin wt - dw^3V_o \cos wt + cw^4V_o \sin wt + fw^5V_o \cos wt \ldots$$

But—

$$w \cos wt = \frac{d}{dt} \sin wt = \theta \sin wt, \quad -w^3 \cos wt = -w^2\theta \sin wt,$$

and so on.

Therefore the expression just obtained can be written—

$$aV_o \sin wt + b\theta V_o \sin wt - cw^2V_o \sin wt - dw^2\theta V_o \sin wt + ew^4V_o \sin wt + fw^4\theta V_o \sin wt - \ldots$$



Digitized by Google

This becomes—

$$[(a - cw^2 + ew^4 - \ldots) + (b - dw^2 + fw^4 - \ldots)\,\theta]\; V_o \sin wt.$$

If we write—

$$p = a - cw^2 + cw^4 - \ldots$$

and—

$$q = b - dw^2 + fw^4 - \ldots$$

we have—

$$(a + b\theta + c\theta^2 + d\theta^3 + e\theta^4 + f\theta^5 + \ldots)\; V_o \sin wt = (p + q\theta)\; V_o \sin wt.$$

Now—

$$(p + q\theta)\; V_o \sin wt = pV_o \sin wt + q\frac{d}{dt}.\; V_o \sin wt$$

$$= pV_o \sin wt + qwV_o \cos wt.$$

Hence in a similar manner to that shown in **2**, we have—

$$(p + q\theta)\; V_o \sin wt = \sqrt{p^2 + q^2w^2}\; V_o \sin\left(wt + \tan^{-1}\frac{qw}{p}\right).$$

Thus the effect of the direct operation—

$$(a + b\theta + c\theta^2 + d\theta^3 + e\theta^4 + f\theta^5 + \ldots)$$

on $V_o \sin wt$ is to multiply the amplitude by $\sqrt{p^2 + q^2w^2}$, and to advance the phase by the angle $\tan^{-1}\frac{qw}{p}$.

The result of the inverse operation—

$$\frac{1}{a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5}$$

on $V_o \sin wt$ will be such that it just neutralises the result of the direct operation $(a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5 + \ldots)$ on $V_o \sin wt$. But the result of this latter operation has been shown to be to *multiply* the amplitude by $\sqrt{p^{12} + q^{12}w^2}$, and to *advance* the phase by the angle $\tan^{-1}\frac{q^1w}{p^1}$, where—

$$p^1 = a^1 - c^1w^2 + c^1w^4 - \ldots$$

and—

$$q^1 = b^1 - d^1w^2 + f^1w^4 - \ldots$$

Hence the operation of—

$$\frac{1}{a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5 + \ldots}$$

on $V_o \sin wt$, which just neutralises this operation, *divides* the amplitude by $\sqrt{p^{12} + q^{12}w^2}$, and *retards* the phase by the angle $\tan^{-1}\frac{q^1w}{p^1}$.

That is—

$$\frac{V_o \sin wt}{a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5 + \ldots}$$

$$= \frac{V_o}{\sqrt{p^{12} + q^{12}w^2}} \sin\left(wt - \tan^{-1}\frac{q^1w}{p^1}\right).$$

The solution of the equation—



Digitized by Google

$$C = \left(\frac{a + b\theta + c\theta^2 + d\theta^3 + e\theta^4 + f\theta^5 + \ldots}{a^1 + b^1\theta + c^1\theta^2 + d^1\theta^3 + e^1\theta^4 + f^1\theta^5 + \ldots}\right) V_o \sin wt$$

is the resultant of the effects of the direct and inverse operations. The solution is therefore—

$$C = \sqrt{\frac{p^2 + q^2w^2}{p^{12} + q^{12}w^2}}\, V_o \sin\left(wt + \tan^{-1}\frac{qw}{p} - \tan^{-1}\frac{q^1w}{p^1}\right),$$

where—

$$p = a - cw^2 + ew^4 - \ldots$$
$$q = b - dw^2 + fw^4 - \ldots$$
$$p^1 = a^1 - c^1w^2 + e^1w^4 - \ldots$$
$$q^1 = b^1 - d^1w^2 + f^1w^4 - \ldots$$

Hence the process for obtaining the alternating current through any circuit is to write the impedance operators $R + L\theta + \frac{1}{K\theta}$ for each branch of the circuit, combine them as if they were pure resistances in the corresponding steady current case, simplify the expression so obtained, and then operate on the applied voltage according to the rule just deduced.

As an example, we will take the case of the current through a coil of wire having a resistance $R$ ohms and an inductance $L$ henrys.

The impedance operator for this circuit will be $R + L\theta$. The corresponding steady current case is $C = \frac{E}{R}$.

Therefore the alternating current through the coil is given by—

$$C = \left(\frac{1}{R + L\theta}\right) V_o \sin wt.$$

Here—

$$p = 1,\ q = O,$$
$$p^1 = R,\ q^1 = L.$$

Hence, applying the rule, we have—

$$C = \sqrt{\frac{1}{R^2 + L^2w^2}}\, V_o \sin\left[wt + \tan^{-1} O - \tan^{-1}\left(\frac{Lw}{R}\right)\right],$$

or—

$$C = \frac{V_o \sin\left[wt - \tan^{-1}\left(\frac{Lw}{R}\right)\right]}{\sqrt{R^2 + L^2w^2}}.$$

If we were dealing with a non-inductive resistance of $R$ ohms in series with a condenser of $K$ farads, the impedance operator would be $R + \frac{1}{K\theta}$, and we should have—

$$C = \left(\frac{1}{R + \frac{1}{K\theta}}\right) V_o \sin wt = \left(\frac{K\theta}{1 + RK\theta}\right) V_o \sin wt.$$



Digitized by Google

In this case—

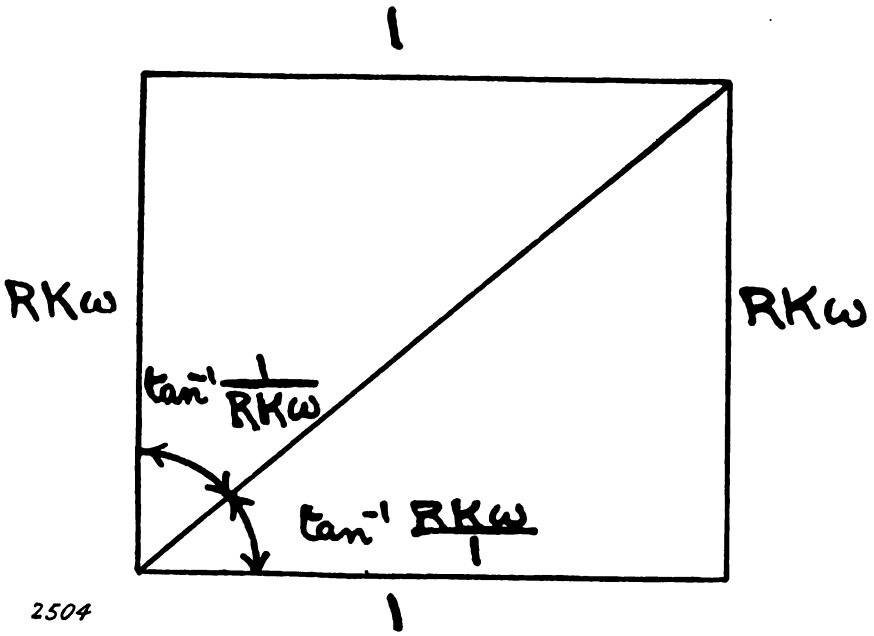
$$p = o,\ q = K,$$
$$p^1 = 1,\ q^1 = RK.$$

Therefore—

$$C = \sqrt{\frac{K^2w^2}{1 + R^2K^2w^2}}\, V_o \sin\left[wt + \tan^{-1}\left(\frac{Kw}{o}\right) - \tan^{-1}\left(\frac{RKw}{1}\right)\right].$$

This may be put in a more familiar form as follows:

We have $\tan^{-1}\left(\frac{Kw}{o}\right) = \tan^{-1}\infty = 90^0$, and it can be seen at once from 4 that—




4. GRAPHICAL ILLUSTRATION THAT $90° - \tan^{-1}\left(\frac{RKw}{1}\right) = \tan^{-1}\left(\frac{1}{RKw}\right)$.

$$90^0 - \tan^{-1}\left(\frac{RKw}{1}\right) = \tan^{-1}\left(\frac{1}{RKw}\right).$$

Further—

$$\sqrt{\frac{K^2w^2}{1 + R^2K^2w^2}} = \sqrt{\frac{1}{R^2 + \frac{1}{K^2w^2}}}.$$

Thus we obtain for the current through the non-inductive resistance and condenser—

$$C = \frac{V_o \sin\left[wt + \tan^{-1}\left(\frac{1}{RKw}\right)\right]}{\sqrt{R^2 + \frac{1}{K^2w^2}}}.$$



Digitized by Google

If now we take a circuit having resistance $R$, inductance $L$ and capacity $K$, as shown in 1, we have for the impedance operator $R + L\theta + \frac{1}{K\theta}$. Therefore—

$$C = \left(\frac{1}{R + L\theta + \frac{1}{K\theta}}\right) V_o \sin wt$$

$$= \left(\frac{K\theta}{1 + RK\theta + KL\theta^2}\right) V_o \sin wt.$$

Here—

$$p = o, q = K.$$

$$p^1 = 1 - KLw^2, q^1 = RK,$$

Therefore—

$$C = \sqrt{\frac{K^2w^2}{(1 - KLw^2)^2 + R^2K^2w^2}}\, V_o$$

$$\sin\left[wt + \tan^{-1}\frac{Kw}{o} - \tan^{-1}\left(\frac{RKw}{1 - KLw^2}\right)\right].$$

As in the previous case we have—

$$\tan^{-1}\frac{Kw}{o} = \tan^{-1}\infty = 90^0$$

and—

$$90^0 - \tan^{-1}\left(\frac{RKw}{1 - KLw^2}\right) = \tan^{-1}\left(\frac{1 - KLw^2}{RKw}\right)$$

$$= \tan^{-1}\left(\frac{\frac{1}{wK} - wL}{R}\right).$$

Also—

$$\sqrt{\frac{K^2w^2}{(1 - KLw^2)^2 + R^2K^2w^2}} = \sqrt{\frac{1}{R^2 + \left(\frac{1}{wK} - wL\right)^2}}.$$

Therefore the expression for the current reduces to the more familiar form—

$$C = \frac{V_o \sin\left[wt + \tan^{-1}\left(\frac{\frac{1}{wK} - wL}{R}\right)\right]}{\sqrt{R^2 + \left(\frac{1}{wK} - wL\right)^2}}.$$

This method of dealing with problems concerning circuits carrying alternating currents is of very great use in connection with the theory of Wheatstone bridge measurements with such currents.

With the continuous current bridge shown in 5, the current through the galvanometer arm is given by the equation—

$$C = \frac{(ad - bc)\, V}{\Delta},$$



Digitized by Google

where $\Delta$ is an expression involving the resistances of the bridge arms. For the bridge to be balanced the current through the galvanometer must be zero, or—

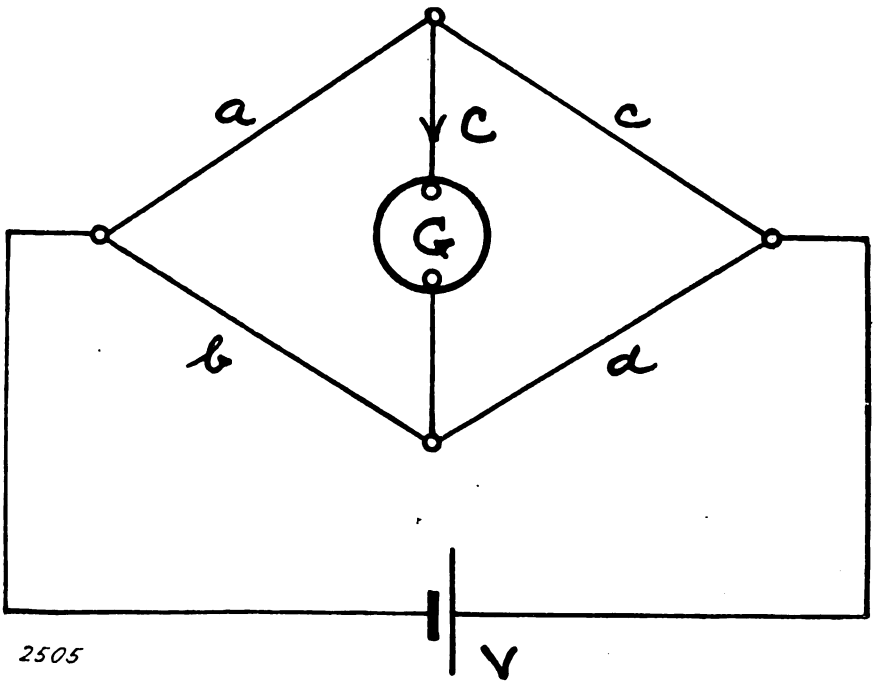
$$\frac{(ad - bc)\ V}{\Delta} = o.$$

Evidently for the continuous current case, this means that—

$$ad - bc = o,$$

or—

$$ad = bc.$$




5.—Continuous Current Wheatstone Bridge.

That is, the products of the resistances of opposite arms of the bridge must be equal.

If we are using alternating currents we must write the impedance operators $R + L\theta + \frac{I}{K\theta}$ in place of the simple resistances of the bridge arms, and then the condition for balance is given by

$$\frac{(ad - bc)\ V_o \sin wt}{\Delta} = o.$$

Where $a$, $b$, $c$ and $d$ now denote the impedance operators for each arm of the bridge. That is, we must have—

$$(ad - bc)\ V_o \sin wt = o$$

or—

$$(ad)\ V_o \sin wt = (bc)\ V_o \sin wt.$$



Digitized by Google

By algebraical simplification, as explained above, this equation can be reduced to the form—

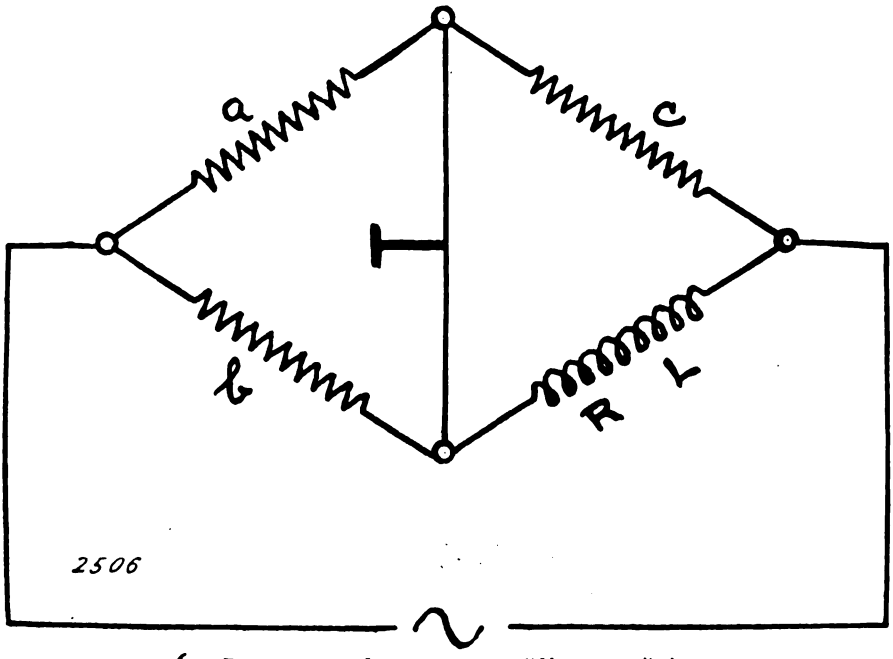
$$\left(\frac{a + b\theta + c\theta^2 + \ldots}{a^1 + b^1\theta + c^1\theta^2 + \ldots}\right) V_o \sin wt = \left(\frac{p + q\theta + r\theta^2 + \ldots}{p^1 + q^1\theta + r^1\theta^2 + \ldots}\right) V_o \sin wt,$$

and this may be still further simplified algebraically to the form—

$$(l + m\theta + n\theta^2 + \ldots) V_o \sin wt = (l^1 + m^1\theta + n^1\theta^2 + \ldots) V_o \sin wt.$$

By what has been said above, this reduces to

$$(P + Q\theta) V_o \sin wt = (P^1 + Q^1\theta) V_o \sin wt$$




6.—Bridge with Inductance in "Unknown" Arm.

where—

$$P = l - nw^2 + pw^4 - \ldots$$
$$Q = m - ow^2 + qw^4 - \ldots$$
$$P^1 = l^1 - n^1w^2 + p^1w^4 - \ldots$$
$$Q^1 = m^1 - o^1w^2 + q^1w^4 - \ldots$$

Hence, equating co-efficients of like terms, we find that the conditions for the bridge to be balanced are that—

$$P = P^1,$$

and—

$$Q = Q^1.$$

Our rule to obtain the conditions for balance of any bridge arrangement whatever is, therefore, to multiply the impedance operators of opposite pairs of arms, and to equate the products so obtained. The products are reduced to the form $P + Q\theta$ and $P^1 + Q^1\theta$, and then the conditions of balance are that $P = P^1$ and $Q = Q^1$.



Digitized by Google

If our bridge arrangement be such that we have a term on one side of the final equation without a corresponding term on the other side, it will be impossible for the bridge to be balanced. Thus, with the arrangement shown in 6 the equation for the conditions of balance is—

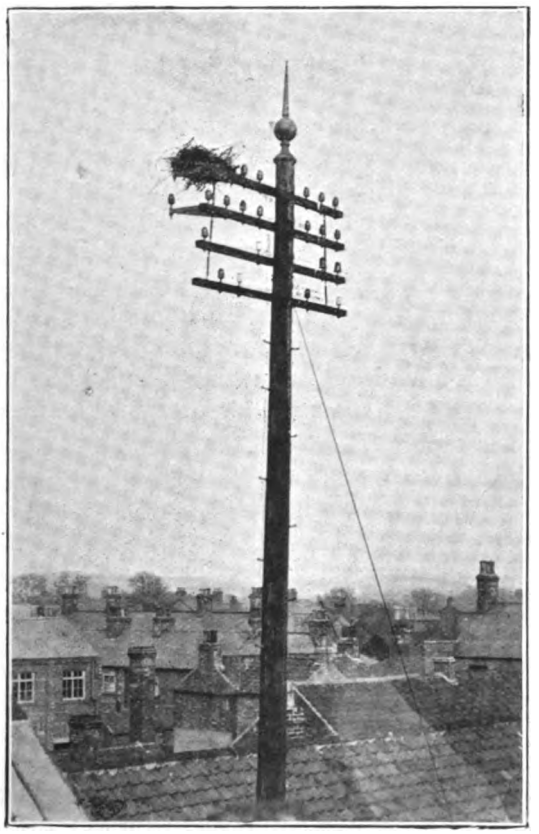
$$a\ (R + L\theta) = bc$$

Since there is no term in $\theta$ on the right-hand side of this equation, the bridge cannot be balanced for varying currents unless $L$ be zero. It is, of course, well known that a bridge with inductance in one arm and pure resistances in the other arms cannot be balanced for alternating or intermittent currents.

*(To be continued.)*

---

## A CURIOUS NESTING PLACE.



THE pole shown in the photograph stands at Pocklington—a quiet little country town in the East Riding of Yorkshire—and was taken



Digitized by Google

over from the National Telephone Company last year. There is no lineman stationed at Pocklington, and a pair of rooks took advantage of the opportunity afforded by the interval between two maintenance visits of the lineman from York to build their nest as shown.

The wires carried by the pole are for subscribers' circuits only, and are of short length. It was found that the service was not materially affected, and arrangements were, therefore, made for the nest to be allowed to remain until the young birds were fledged, unless, in the meantime, some serious inconvenience had resulted. It may be mentioned that the subscribers were not only willing, but anxious, for the nest to be allowed to remain, and, indeed, the whole of the little town has been interested in the case. I am glad to say that the birds have been safely hatched and fledged and that the nest has been removed. T. B. J.

## THE FIRST TELEGRAPH ENGINEER.

If our readers were asked who was the first telegraph engineer, it is likely that the greater number would name Wheatstone or Morse. As a matter of fact, however, although these two scientists are associated with the origins of commercial electric telegraphy, the telegraph engineering profession was already nearly half a century old when their inventions were produced.

In 1794, during the French Revolution, a French military engineer named Chappe devised a method of signalling by means of movable arms mounted on an upright, and lines of stations so equipped were used to transmit important despatches with, up to then, unheard-of rapidity.

The following extract from Carlyle's 'French Revolution' describing the birth of this invention may be new to some of our readers.

"What, for example, is this that Engineer Chappe is doing, in the Park of Vincennes? In the Park of Vincennes; and onwards, they say, in the Park of Lepelletier Saint-Fargeau the assassinated Deputy; and still onwards to the Heights of Ecouen and farther, he has scaffolding set up, has posts driven in; wooden arms with elbow-joints are jerking and fugling in the air, in the most rapid mysterious manner! Citoyens ran up, suspicious. Yes, O Citoyens, we are signalling: it is a device this, worthy of the Republic; a thing for what we will call *Far-writing* without the aid of postbags; in Greek it shall be named 'Telegraph.'—*Télégraphe sacré*! answers citoyenism: For writing to Traitors, to Austria?—and tears it down.



Digitized by Google

Chappe had to escape, and get a new Legislative Decree. Nevertheless he has accomplished it, the indefatigable Chappe; this his *Far-writer*, with its wooden arms and elbow-joints can intelligibly signal; and lines of them are set up, to the North Frontiers, and elsewhither. On an Autumn evening of the Year Two, far-writer having just written that Condé Town has surrendered to us, we send from the Tuileries Convention-Hall this response in the shape of Decree: 'The name of Condé is changed to *Nord-Libre*, North-Free. The Army

CHAPPE (INVENTOR OF SEMAPHORE).

of the North ceases not to merit well of the country.'—To the admiration of men! For lo, in some half hour, while the Convention yet debates, there arrives this new answer: 'I inform thee, *je t'annonce*, Citizen President, that the Decree of Convention, ordering change of the name Condé into *North-Free*; and the other, declaring that the Army of the North ceases not to merit well of the country; are transmitted and acknowledged by Telegraph. I have instructed my Officer at Lille to forward them to North-Free by express.—*Signed* CHAPPE.'"

This system became so rooted in France that when the electric telegraph was introduced into that country fifty years later instru-



Digitized by Google

ments were designed in which needles were deflected so as to form the same combinations which were previously used with the Chappe Telegraph.

Our illustration shows the statue of Chappe and his semaphore which has been erected in Paris.

---

# THE GHENT EXHIBITION.

By H. North.

After apparently sleeping for centuries, Ghent has awakened to its possibilities and is rebuilding itself. Situated on the main line to Brussels, Ghent forms an ideal spot for exhibition purposes.

The authorities have built a palatial station adjoining the Exhibition grounds, whilst in every direction beautiful buildings and gardens have been constructed to make the otherwise dreary waste picturesque. The Exhibition grounds cover some 300 acres and include a beautiful natural park situated on high ground. In this part has been placed the outdoor attractions. The grounds at night are a veritable fairyland, with the thousands of coloured lights intermingled with the flowers and shrubs for which Ghent is so famous.

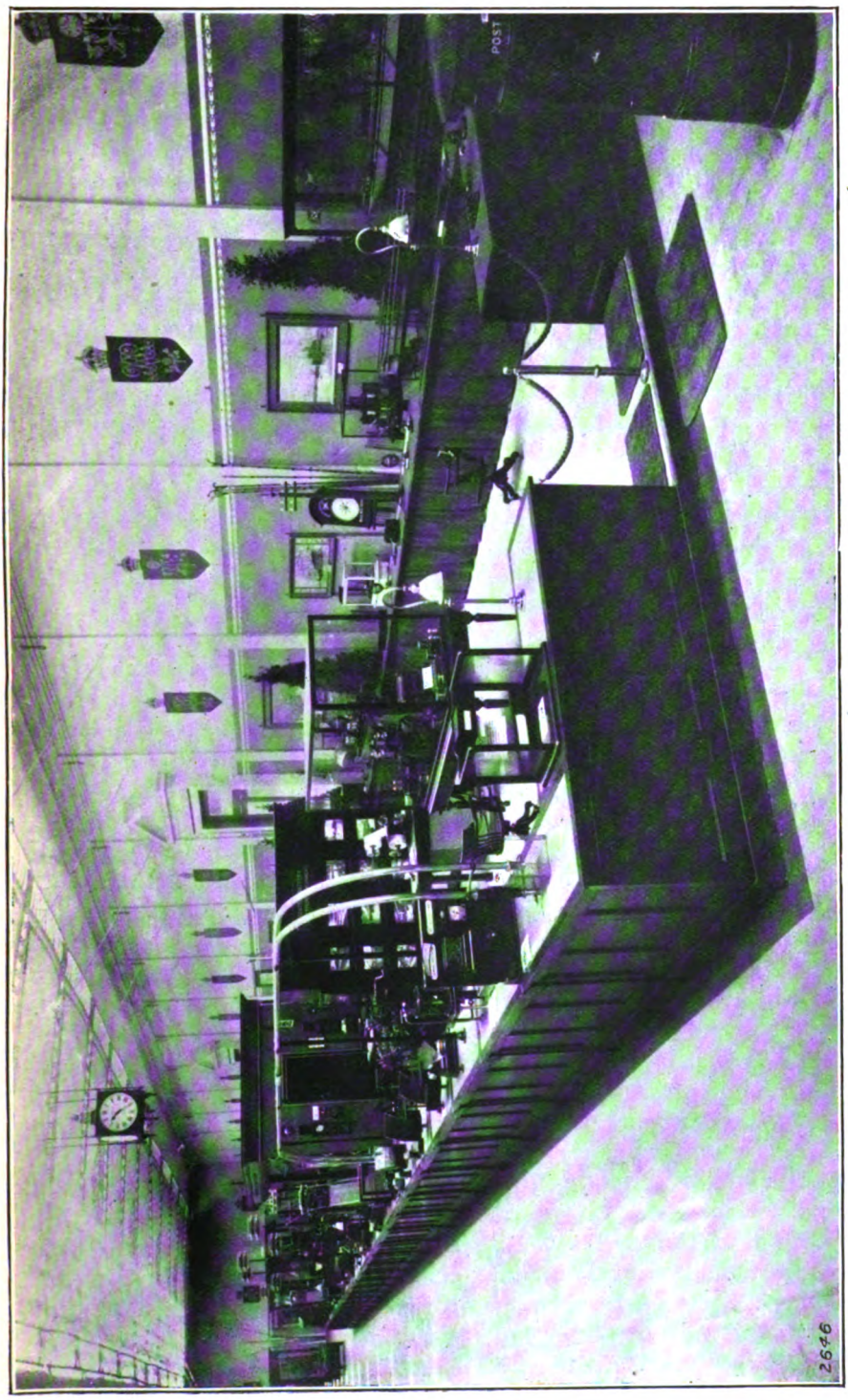
The Exhibition proper is situated upon fairly flat land, and is constructed upon similar lines to the Shepherd's Bush Exhibition. To attempt to describe the whole of the exhibits would take more space than is at my disposal, so I will confine myself to the

## British Post Office Exhibit.

A complete gallery 328 ft. by 50 ft. has been allotted to the Post Office exhibit, and it is probably the finest display of the various departments which constitute the Post Office ever brought together. Postal, Telegraph, Money Order, and Savings Bank Departments have each sent the best stock to make up the whole. Entering the gallery, which, by the way, is artistically decorated with flowering shrubs, trees, shields, banners, etc., the foreground is occupied by the magnificent model of the R.M.S. "Olympic" belonging to the White Star Line. On either side are arranged the various appliances used in dealing with the conveyance of mails, including sorting tables, baskets, bags, letter-boxes, etc. An excellent display of telephone parts and cables sent by the Western Electric Company is also assembled here. The centre of the gallery has a raised platform 150 ft. by 24 ft. surrounded by a counter. Above this is a four-faced turret clock designed by the Silent Electric Clock Company, and controlled, together with four other clocks, by a



Digitized by Google




GHENT EXHIBITION. BRITISH POST OFFICE EXHIBIT. VIEW FROM NORTH END OF GALLERY. [*Photo. by Samson et Cie.*



Digitized by Google

master clock. Following the counter round to the right, postal items, including a working model of Sauvee's Facing Table and the model illustrating the collection and despatch of mails from a train in motion are shown, together with the usual counter equipments—the whole being surmounted by a model telegraph pole line illustrating the erection of open wires run on the straight and also revolved.

To the right of the counter, the following working exhibits are arranged :

A House Tube, with glass tube showing the carrier in transit ; Double Slide Switch ; Wheatstone A.B.C. ; Double Plate Sounder ; Single Current Simplex ; Double Current Duplex ; Helsby Cord Carrier ; Hughes Type-printer ; Typewriter with Sounder on extended arm ; Wheatstone Duplex with perforators, including the Gell ; Distribution Board for power working ; Lamson Pick-up Carrier ; Gent's Water Level Apparatus ; High and Low Level Alarm ; Water Level Recording Apparatus; Quadruplex (two sets) ; Siemens Baudot with Wheatstone Set and Automatic Switch, and a Fast Speed Repeater ; also Writing Desks fitted with automatic telegraph form boxes at suitable intervals.

In the centre of the enclosure are arranged in glazed cases the various Testing Appliances and also a case of Historical Telegraph Apparatus, whilst in the Demonstration Boards supplied by the Western Electric and Peel-Conner Companies are to be found the latest types of apparatus used by those firms for Manual Telephone Exchange Equipments—arranged in the form of model "A" and "B" operator's positions ; a Condenser Winding Machine (Mansbridge), and an electrophone equipment, two tables being placed immediately in front of the office. A stand has been reserved for Automatic Telephone Apparatus in a corresponding position on the other side.

On the outer sides of the counters models of mail steamers, also descriptive pictures and flags make an excellent background. These are interspersed with suitable construction appliances and tools. Samples of cables, cells and apparatus loaned by Messrs. Siemens also form an attractive show.

At the south end of the gallery cases containing telephone parts (Peel-Conner Company), Telegraph Poles, Creosoting Plant (Burt, Boulton & Haywood), Jointing Chamber, Jointers' Tent and Appliances, Letter Boxes, Stationery and Stores, and Samples of Uniform Clothing. A relief map of South America illustrating the existing mail routes and the changes to be effected when the Panama Canal opens, together with the exhibits sent by the Money Order and Savings Bank Departments, have been arranged to give the best possible effect to each exhibit.



Digitized by Google

GHENT EXHIBITION. BRITISH POST OFFICE EXHIBIT. VIEW OF SOUTH END OF GALLERY. [*Photo. by Samson et Cie.*



Digitized by Google

The working exhibits are driven from power obtained from the town mains at 6000 volts alternating, transformed in the British section to 220 volts D.C. A board has been fitted to distribute the various voltages to the respective exhibits, the motors taking 220 volts and the telegraph apparatus 88 or 22 volts.

Accumulators are provided for the demonstration boards, the ringing machine being driven from the 220-volt mains.

A very representative collection of historical telegraph and telephone apparatus has been displayed to fill in between their modern brethren.

The section was opened to the Press on Sunday, May 11th, and the British Post Office gallery was crowded all day, the general opinion being that it constituted the most attractive single exhibit in the whole Exhibition.

Between two and three hundred separate packing cases had to be dealt with, some of these weighing upwards of two tons, containing in all several thousand items.

It may interest readers to know that each packing case was allotted a code and number, which enabled the authorities to place the package upon the spot it was to occupy—blue prints of the lay-out being supplied to those concerned, and when the whole of the exhibits were checked, with the exception of one or two minor items —probably still in the packing—everything was found in order.

The work of installation occupied about four weeks, every assistance being afforded by the Board of Trade (Exhibition Branch) officials.

---

## "P.O.C.B.F."

By A. J. STUBBS, M.Inst.C.E.

IN these days, when our general tendency is to express ourselves by initials, one often feels doubt as to whether the initials are quite clearly understood except by the initiated. For instance, in response to my query on a recent occasion put consecutively to two officers, "By-the-bye, what does 'W. P. M.' mean?" I was told by the telegraph man "words per minute," while the construction man, with as little hesitation, said "weight per mile!" Of course, everyone knows the story of the disappointment of the fond mother, keen on missionary work, who found that the several entries in her schoolboy son's cash account of "S. P. G., 6*d*." had no connection with the Society for Propagation of the Gospel, but meant merely "Sundries, Probably Grub!" To prevent any misunderstanding of the heading of this note, therefore, I had better explain that the letters stand for Post Office Clerks' Benevolent Fund.



Digitized by Google

This fund was founded in 1853 to provide by collective effort more substantial and more systematic relief for cases of distress among the dependents of retired or deceased Post Office major establishment officers than could be ensured from private benefaction.

It is administered by a committee of representatives from all subscribing branches of the Post Office, and, being a society for mutual help, subscriptions are sought only from officers of ranks which would be eligible to receive benefit.

Thus, many years ago the committee (without any idea of meddling in a delicate question) decided that for the purposes of the fund a Post Office engineer is a "clerk." Recently, on my representation, it was agreed that established draughtsmen also are eligible.

As representative of the Engineering Department I must, however, confess that my difficulty has been, not to find who is eligible, but to find that the eligible are also willing. On scrutinising the list of Engineering Department Subscribers for 1912–13 I found that it was represented by 108 names; of whom 78 were "Engineers" and 30 were "Clerks" of all grades. Of this total 47 are at Headquarters.

On inquiry I find that there are at the present time the following numbers of officers who are eligible to become subscribers:

At Headquarters, 371 (156 engineers and 215 clerks).

In Districts, 2206 (819 engineers and 1387 clerks).

In response to an appeal which Heads of Sections and Superintending Engineers were good enough to bring to the notice of their Staff, an addition of 65 names has been received this year at time of writing. This is encouraging; so much so that I believe it is being made the basis of further effort in other departments. Yet do I feel constrained to ask for more. In this cause I would even go so far as to attempt by comparisons to provoke my colleagues to take part in this good work. I feel uncomfortable and a little jealous for the honour of the Engineering Department when I see that against our £28 14*s.* 10*d.* collected last year the Stores Department with Factories Section sent in £54 2*s.* 8*d.*

The ordinary subscription of a penny a week can be paid by half-yearly deduction from salary; and few salaried officers would seriously miss this small sum paid in this way. Of course it can also be paid direct to me in cash, but the half-yearly deduction is rather more convenient. Those with higher means or fewer calls are invited to make the 4*s.* 4*d.* into 10*s.*, in which case the 4*s.* 4*d.* goes to the "Urgent Distress Fund" and the balance to the "Pension Fund," which latter provides for the grant of small pensions to the widows of officers who at the date of their decease were subscribers to the Pension Fund, but who have left their widows in needy



Digitized by Google

circumstances. This leads me to note that there is no risk of the Fund proving in any sense anti-thrift. In its earlier days no doubt it rendered very greatly needed aid towards repairing the ravages of improvidence; and even now there may occasionally be cases of this sort. But the real point is that, however working conditions may change, and however thoroughly the general community may be imbued with the principles of thriftiness, there will not cease to be occasions when the stretching out of a strong helping hand will keep someone from sinking beneath a burden too heavy to be borne unaided. Who, for instance, would grudge a grant to the young widow of a clerk cut off by an early death and leaving only a small sum from an insurance policy? Who would speak of improvidence when the burden of the expense of the last stages of a brother officer's painful illness was ever so little eased by the sympathetic benevolence of his colleagues? Who would not be glad to share when assured that help given for three or four months at a critical time would probably wrest a young married man from the fatal grip of consumption and restore him in good health to resume his place amongst us for many years? These are recent actual cases—cases, indeed, which induced in me the determination to make this further appeal to the Engineering Department to take a larger share in the effort that is being made in this sixtieth year of the existence of the Fund to bring the number of subscribers up to 2000. Last year it was 1875, "thanks chiefly to a *substantial* increase in the number of supporters from the Stores Department," but losses by death, etc., involved that 77 new subscribers resulted in a net increase of only 5, so that there is need for considerably more than 125 new subscribers if the ambition of the Committee is to be attained. Given the same loss nearly 200 must be added. Is it very unreasonable to hope that our Department will produce 100?

It is worth while to mention that the Fund has been made the almoner of a presentation to Christ's Hospital, and that a further direct presentation to the School for a girl will be at the disposal of the Committee early in 1914. Also there will probably be a nomination to a competitive entrance examination in October next. These privileges are administered in association with the general purposes of the Fund.

The sole expenses of administration of the Fund are for postage, stationery, etc., and the printing of the Annual Report.

I think that it will be understood that, although the "Urgent Distress Fund" is open to assist any needy case, the "Pension Fund" is administered only for benefit of dependents of subscribers to that Fund. One does not need a very vivid imagination to recognise what a pension for the first few years must mean to a young widow while she is confronting her new conditions and preparing for



Digitized by Google

her years of single-handed battle—often to be fought mainly for the children's sake. Perhaps some present subscribers of 4*s.* 4*d.* will wish, when they come to think it over, to join the thirty-three who now give the extra 5*s.* 8*d.* a year to strengthen the Committee's hands by lengthening its purse in this connection.

---

## AWARDS.

By W. D. ROBINSON.

THE "Awards Committee" of the British Post Office was created some six years ago, for the purpose of considering proposals for improvements and innovations made by Post Office employees. If any proof of the important work performed by the Committee is required, it is furnished by the ever-increasing number of suggestions submitted for consideration. These have risen from 344 in 1906–7 to 901 in 1911–12; and, with the absorption of the National Telephone Company, these figures will undoubtedly advance still further. Included in the figures given above are suggestions relating to postal matters, which, strange as it may appear, considering the comparatively small scope for improvements in postal appliances, etc., now outnumber the suggestions received from the engineering side of the Service, where there is a much larger field for the inventor. On the other hand, the percentage of engineering suggestions adopted by the Department is considerably greater than that of postal; the average for the past six years has been 22·8 per cent., but the large majority of the suggestions have required more or less extensive modification before they could be considered satisfactory.

The figures quoted indicate that, given a fair amount of encouragement and a reward for improvements which may be suitable to the needs of the Department, ideas and devices are submitted which would in many cases otherwise lie dormant.

The fact that an officer in the Service is able to submit a suggestion direct to an independent tribunal whose primary function is to consider it from the standpoint of reward to the inventor, instead of through the ordinary official channels, inspires confidence, and creates a feeling that the suggestion will be considered apart from official exigencies.

The story goes that in one of the larger Departments of the Post Office (*not* the Engineering Department by the way), there were three rules governing the consideration of suggestions: the first was "Damn it if you can," the second rule was the same, and the third ditto! Obviously this story is the outcome of inane suggestions submitted by individuals to their supervising officers, who were more impressed by the waste of time occasioned than by the ability of the "suggester."



Digitized by Google

Like all good things the Awards scheme has encountered its full share of criticism. Some of its critics are merely to be classed with those who have failed to move with the times and consequently regard all innovations with disfavour. Others, with which one has more sympathy, have found their official worries appreciably increased by the necessity for sifting a very large amount of chaff in order to ensure that the modicum of wheat which it contains shall not be lost. Some individuals look upon the Committee as a failure because their suggestions or ideas have not been readily adopted!

Those well acquainted with the working of the scheme, however, realise that the Committee is not only doing good work in encouraging suggestions and rewarding the originators, but that its field of usefulness extends to broader limits. One cannot estimate the results which may accrue as the outcome of discussion in committee on a very simple suggestion. Cheaper methods of production or changes in administration, quite outside the scope of the suggestion originally made, may frequently result to the benefit of the Department.

It will readily be understood that an article on the lighter side of the work of the Committee would make interesting reading, but this would perhaps be breaking faith with the employees responsible for making suggestions, which have caused more amusement than admiration.

It occasionally happens that a suggester is so full of his idea, and the wonderful results it will produce, that he thinks the Committee must agree with him, and so he fails to mention what piece of apparatus he is seeking to improve! In one instance, instead of a description of the apparatus being given, the only statement made was—"My rate is $4\frac{1}{4}d.$ per hour."

On the whole the tone and quality of the suggestions are fairly good and the number of "howlers" is small. The latter are, of course, treated quite seriously so far as the originators are concerned, for it is a *sine quâ non* that *every* suggestion should be so treated.

---

## CONFERENCE OF SUPERINTENDING ENGINEERS.

On May 6th last, the Heads of the Post Office Engineering Districts met in Conference at Southport under the chairmanship, for the first time, of Mr. W. Slingo, Engineer-in-Chief. The gathering was a representative one, as will be seen from the frontispiece, which we are happy to place in the hands of our readers, portraying, as it does, every Post Office Superintending Engineer of the present day.



Digitized by Google

That this Conference was one of unusual importance was made evident in the first half hour of the proceedings, when the Engineer-in-Chief outlined the principal considerations underlying the need for the personal discussions, and explained that, owing to the urgency and amount of the business of the Conference, it would not be practicable, as on previous similar occasions, to pay visits to works, etc. The subjects dealt with on the first day related chiefly to proposals for devolving work from the Engineer-in-Chief to Superintending Engineers, and from the latter to Executive Engineers, and to the bases for providing and organising the clerical staff. On the second day further attention was devoted to organisation and staff matters, the outstanding features being an instructive address by the Engineer-in-Chief concerning the minor staff revision of 1911, the dearth of skilled workmen, and the employment of acting inspectors, and a helpful statement by Mr. Noble concerning matters affecting the staff transferred from the National Telephone Company. During the following days (Thursday and Friday) Mr. A. Watts read an interesting preliminary paper on "Engineering Calculations for the Provision of Outside Plant," the Engineer-in-Chief outlined the methods which should be employed for co-ordinating main line construction work, and for keeping in touch with the progress of works, particularly in relation to the annual programme, and Mr. J. Sinnott explained a scheme which had been prepared for simplifying procedure in dealing with estimates.

The keenest interest was naturally shown in the proceedings of the Conference, and, at its conclusion, the members expressed their great appreciation of Mr. Slingo's introductory remarks and summing-up on the various subjects. In his reply, Mr. Slingo said that considerable advantage would undoubtedly result from the meeting and hoped that it would be possible to hold a similar conference next year.

---

## ENGINEER-IN-CHIEF'S CHESS CLUB: ANNUAL DINNER.

THE ninth annual dinner was held at the Holborn Restaurant on April 1st, the Engineer-in-Chief (President) being in the chair. Mr. Slingo was supported by Mr. Stubbs, Mr. Noble, Mr. Martin Roberts, Mr. Kempe, Mr. Hartnell, Mr. Moir, and the Club Captain, Mr. Anson; and among the ladies present were Mrs. Slingo, Mrs. Moir, and Mrs. De Lattre.

The Chess Club Dinner has now become the principal social event of the year at headquarters, and this year advantage was taken



Digitized by Google

of the occasion to present an illuminated address to Mr. Kempe, who has been a vice-president of the Club since its inception.

Mr. SLINGO, in proposing "The Chess Club," said that it was a very pleasant duty to wish prosperity to the Chess Club. He had been going to say "the continued prosperity of the Chess Club." Why he hesitated was because of the very great, heavy and strenuous game in which they had all been so closely interested during the last

To
Harry Robert Kempe
M.Inst.C.E., M.Inst.M.E., M.Inst.E.E.
The Colleagues and other Friends
whose names are appended, desire to
express to you their hearty Good wishes
on the occasion of your retirement from
the position of
1870 HR 1912
Electrician
to the
Post Office
During a long, useful and honourable
service you have earned the
affectionate esteem of all with whom you
have been associated, and they trust that
for many years the Gifts that accompany
this Address will constitute a continual
reminder of the Friendship that animates
the Givers.
2605

ILLUMINATED ADDRESS PRESENTED TO MR. H. R. KEMPE.

few years. No doubt many chess players had had their attention wholly taken up with the work of the Department. They had played a part which had prevented their following to the full this most interesting pursuit, and consequently they had been prevented from promoting the success of the Chess Club. Of course, the success of a club of that kind depended upon its members, and he could only hope that the Chess Club would make up for lost time, and would stave off all danger of relegation to the Second Division.

Mr. Slingo said that he was happy to take this opportunity of



Digitized by Google

referring to Mr. Kempe, who had been vice-president during the whole lifetime of the Club, and who had now retired from active service. He felt sure that Mr. Kempe was still with them as in the past, and that he cherished a lively recollection of his association with the Club. The occasion of this dinner was being used to present Mr. Kempe with an autograph album, suitably addressed, as a supplementary item to more substantial tokens which had already been presented to him. The names in the album were those of colleagues, who wished Mr. Kempe many years of retirement and happiness.

Mr. Slingo handed the album to Mr. Kempe, and then said that he had pleasure in uniting the toast of "The Chess Club" with the name of Mr. Kempe.

Mr. KEMPE, in replying, said that he still felt a little lost after his long service in not having to make the journey to the office each day, but he hoped to get over it in time. He was very sorry to leave his old colleagues, but he did not mean to lose touch with them.

Mr. BARTHOLOMEW replied for the Club in an amusing speech. He pointed out that the Club held a rather lowly place in the Division I of the Civil Service League this year, but that this was due to the difficulty of getting together representative sides owing to the arbitration proceedings.

Mr. STUBBS proposed the health of "The Visitors," and after welcoming the ladies, he indulged in a few reminiscences concerning his long association with Mr. Kempe. He was also very pleased to see Mr. Roberts and Mr. Hartnell, and hoped that they would again honour the Club with their presence.

Mr. ROBERTS, in thanking Mr. Stubbs, said that he would be very pleased to be present at future gatherings. Although it did not fall within his province, he felt that he must refer to his old friend Kempe. He thought that Mr. Kempe should not let his retirement affect him too much. After he had retired, he actually found himself outside the Post Office in the morning on one or two occasions, but he soon got over it, and he was sure that Mr. Kempe would soon find that all the advantages did not lie in the active service of the State.

After Mr. SHAUGHNESSY had proposed the toast of "The President," which was accorded musical honours, a very pleasant evening came to a close with the singing of "Auld Lang Syne."

The musical programme was, as is usual at these functions, quite a feature of the evening, and thanks are due to Mr. Sivori Levey for his excellent arrangements.

The address and autograph album presented to Mr. Kempe was a very fine piece of work in book form, and was produced by Messrs. Partridge & Cooper, of Fleet Street.



Digitized by Google

# HEADQUARTER NOTES.

## Manual Equipment.

Orders have been placed for the equipment of new exchanges at:

| | | | |
|---|---|---|---|
| Barnsley | 480 lines | Museum | 9700 lines |
| Kilmarnock | 440 „ | Tunbridge Wells | 1200 „ |
| Llanelly | 400 „ | | |

Extensions of existing exchanges have been authorised and orders placed in the following cases:

| | | | |
|---|---|---|---|
| Chester | 480 line extension | Kingston | 540 line extension |
| Doncaster | 280 „ „ | | |

Installation of new exchange equipment is proceeding at:

| | | | |
|---|---|---|---|
| Attercliffe | 480 lines | Port Talbot | 400 lines |
| Barrow-in-Furness | 600 „ | South Shields | 720 „ |
| Helensburgh | 500 „ | Victoria | 8100 „ |
| Mansfield | 640 „ | | |

Extensions of existing exchanges are proceeding at:

London, City, conversion of junction to keyless working.
„ Dalston, 2400 line extension.
„ East, 520 line extension.
„ Hampstead, information desk.
„ Hop, 1720 line extension and conversion of junctions to keyless working.
„ Kensington, 3310 subscribers' lines and 270 incoming junction line extension.
„ Regent, 5700 line extension.
Leith, 220 line extension.
Manchester City, 1300 line extension.
Rusholme, 280 line extension.

## Automatic Telephone Development.

A contract has been placed with the Automatic Telephone Manufacturing Company for an automatic exchange at Leeds. The building, which will be in Basinghall Street, is now in progress.

The present telephone exchanges in Newport (Mon.) and Portsmouth are to be replaced by combined trunk and automatic exchanges, and will be installed by the same firm.

The Western Electric Company has been instructed to proceed with the manufacture of an automatic and trunk exchange—the first of its kind in the United Kingdom—for Darlington. It will supersede the present magneto equipment, and will be installed in an extension of the post office.



Digitized by Google

Tenders have also been invited for trunk and automatic equipments at Paisley, Accrington, Stockport, Dudley, and Grimsby.

An automatic exchange of a specially compact type, suitable for small exchanges unattended at night, is to be installed at Chepstow as an experimental equipment.

An adaptation of semi-automatic working will be installed at Paddington exchange in the shape of automatic distribution of traffic for 1000 busiest circuits. Calls will be fed uniformly to all the operators concerned, and by closing down positions as work falls off a system of concentration for slack periods will be available.

### Local Line Development.

Consequent upon the overlapping of the late National Telephone Company's and Post Office exchange areas in London, arrangements have been made to effect the transfer of a large number of exchange circuits to their proper exchange. Approximately 2200 lines were transferred in July, 1912; 4213 on the 1st January last; and a further 4700 lines on the 1st July of this year.

There is urgent need for the provision of underground plant to meet the present and prospective requirements of local subscribers' service in practically every telephone area in the kingdom, and schemes have been approved and work is actually in progress in 58 towns, including the London telephone area.

---

## LONDON DISTRICT NOTES.

The switchboard contractors made a start on the equipment of the new Victoria exchange on March 13th. Capacity for 8100 lines is being provided. The exchange premises will include engineering offices, stores, and a fitting office. It is anticipated that the transfer of the lines will take place before the end of the current year.

The completion of the new Museum exchange premises is being delayed on account of a plasterers' strike. The exchange is due for opening concurrently with the issue of the January subscribers' list.

An extensive addition is being made to the Kensington exchange, involving considerable structural alterations. The extension includes forty-two "A" positions and the conversion of nine "A" positions for "B" working. The power plant is being reconstructed and added to, and a new test-board is being placed where the old power plant stood.

A new suite of sections, comprising thirty-one "A" positions,



Digitized by Google

has been added to the Hop exchange. The work of converting the "B" positions for keyless working, and at the same time increasing the number of cord circuits, is proceeding.

The Ealing switchboard is being extended, and provision is being made for local trunk working.

Extensions are also in progress at Regent, Lea Green, Tottenham, and Battersea.

G.P.O. South, which houses the Central, City and Trunk exchanges, is always a hive of industry, and from the time the first Central exchange was built, extensions or alterations have been in progress. At the present time a 12-position information desk is being installed in the Central exchange, and the desk that this replaces is to be reconstructed and fitted up in the City exchange for a similar purpose. The power plants are being modified. Testing operators' positions are being installed at both exchanges, and in the City exchange the "B" positions are being converted for keyless working. There are other works in hand here, but those mentioned are the principal.

## New Telephone Lines.

During the thirteen weeks ended May 31st, 1913, 4832 exchange lines, 2884 internal extensions and 304 external extensions were completed. In the same period 3088 exchange lines, 1515 internal extensions and 200 external extensions were recovered, making a net increase of 1744 exchange lines, 1369 internal extensions and 104 external extensions.

In the same period 5400 removals were carried out.

## Up-to-date Methods.

During the past few years the extreme heat caused by the combination of oxygen with acetylene gas, through a suitable blow-pipe, has been adapted to the cutting of large pieces of metal with very satisfactory results, securing considerable economies as compared with the former method of performing the operation. This system has recently been adopted in connection with certain works in the City Section of the London Engineering District. In one case a large "derrick" constructed of heavy angle iron and steel girders situated upon a roof about 90 feet high and formerly used for carrying some 28 heavy telephone cables and a large number of open wires, and weighing about 5 tons, had to be removed owing to building extensions. This structure was cut into sixteen pieces by means of the oxy-acetylene blow-pipe. Three minutes was the time occupied in completing each cut, which was made through wrought iron vary-



Digitized by Google

ing in thickness from ½ to 1½ in. It was thus possible to cut up and clear away the whole structure within one day.

Hadth e cutting been done in the ordinary way by a saw, from five to six hours per cut would have been expended, and fully a week would have elapsed before the structure would have been removed.

In another case the corner of a ½-in. iron boiler plate forming a portion of the roof of a large manhole in the City had to be cut away, *in situ*, in order to allow of certain repairs being carried out to an electric light cable. The length of the cut was 20 in. and the time taken four minutes.

A very considerable saving was effected in both these cases by the adoption of the method mentioned.

## London District Social Gathering.

The first annual gathering of the London Engineering District was held at the Holborn Restaurant on April 26th, and consisted of a triple function, dinner, concert and dance, which proved to be a most successful and enjoyable innovation.

About 300 guests partook of an excellent dinner in the King's Hall, the guests including, in addition to Mr. Slingo, the Engineer-in-Chief, and Mrs. Slingo, Mr. A. M. Ogilvie, Third Secretary; Mr. Morgan, Controller of Stores, and Mrs. Morgan; Mr. C. B. Clay; Mr. Dalzell; Mr. Valentine; Mr, Prout; and many others.

A feature of the arrangements which was not without appreciation was the fact that only two speeches were delivered, from which we give the following extracts:

Mr. Ogilvie, in proposing the toast of the London Engineering Staff, said that he wished to congratulate the committee on the presence of so many ladies at their gathering, and also on the fact that a considerable part of the evening was to be devoted to amusements of a more interesting and cheerful kind than the lengthy speeches which were too often a feature of official dinners.

He was very glad to be present on the occasion of the first gathering of the large and important staff which was entrusted with the serious responsibility of providing for the telephone service in the whole of the London area with the exception of certain outlying rural portions. The London telephone system was the third largest in the world, if the number of telephones were reckoned, and he believed that if the number of subscribers were counted it might even occupy the second place. The number of exchange and private wire telephones now working was about 250,000, or about one third of the whole number in the United Kingdom. The mileage of telephone wire maintained by the staff was something like a quarter of the whole mileage in use in the service. On the other hand, the



Digitized by Google

engineering expenditure was only about one fifth of the whole expenditure, so that it could not be said that the efficiency of the London service was gained at the expense of economy.

He wished to couple the toast with the name of Mr. Moir, whose excellent qualities were, he felt sure, as much appreciated by those who work under him as they were by the Postmaster-General and the departmental chiefs. Mr. Moir had not only great technical and administrative abilities, but he devoted much time and thought to the improvement of the efficiency and the welfare of every member of the staff.

In responding on behalf of the London Engineering Staff, Mr. MOIR stated that the most important item of work which they had had to deal with during the previous twelve months was the reorganisation of the District carried out on November 1st last. The organisation taken over from the Company was of a functional character, the Post Office organisation being functional as regards the different classes of workmen, but territorial from the supervision point of view. It became necessary to adopt functional organisation throughout, and many difficulties were encountered before the change could be effected. To do away with overlapping and provide sections which could be economically worked, the number of points at which sectional engineers were stationed was reduced from thirty-two to fourteen. Altogether something like 4000 men were affected by the reorganisation, which was carried through in a very satisfactory manner. They were looking forward to the opening of the new exchanges at Victoria and Museum at no distant date, and to the transfer of another batch of 5000 subscribers to their appropriate exchanges on July 1st. He expressed the hope that the development forecast for London would shortly be completed, so that they might be able to proceed with any leeway in cabling, on a sound foundation.

In connection with the telephonic development, it was desirable that some of the London boroughs might be persuaded to take a larger view of their obligations to the Postmaster-General than they did at present. No fewer than eighty separate road authorities existed in London, and wayleave correspondence with some of them was very protracted. In one case just completed the correspondence about a single pole extended over 159 days.

He explained that a new building at Denman Street, in which the whole of the headquarters staff of the district would be accommodated, had been sanctioned. Commodious, well-lighted rooms had been provided by the architect, and no time would be lost in proceeding with the erection of the building, as the present arrangement under which the clerical staff was divided between two centres, four miles apart, was not a convenient one.

In conclusion he stated that the District was a very large one,



Digitized by Google

and it was necessary that the scheme of administration should be thoroughly understood and the lines of functional responsibility clearly defined and followed. There must be enthusiasm, efficiency, and skilled workmanship of the highest grade. He knew that he could rely upon the whole-hearted support not only of his immediate assistants, but of the whole body of the staff, and that being so there was no doubt that they would continue to give a good account of themselves in connection with the London Engineering Service.

The Throne Room was reserved for dancing, and excellent music was provided by Jeffrey's Quadrille Band.

It was unanimously agreed which the gathering was one of the most enjoyable and successful which has been held in connection with any of the London Departments.

## LOCAL CENTRE NOTES.

### LONDON CENTRE.

THE Annual General Meeting of the Institution was held in the Lecture Theatre of the Institution of Electrical Engineers on April 21st, the President being in the chair. Only formal business was transacted, the report as read by the Secretary showing a gratifying progress in the various departments of the Institution.

On May 26th and 27th a party of members visited H.M. Cable Ship "Monarch," at Woolwich. The thanks of the Institution are due to Mr. Pollard and the members of his staff for the very courteous reception accorded the members, and for the efforts which they made to make the visits instructive and interesting.

The Centre was represented on the Monday by Mr. J. M. Shackleton, and on Tuesday by Mr. D. H. Kennedy.

The thanks of the Committee are also due to the Superintendent of the line of the S.E. and Chatham Railway, who so kindly placed at their disposal the necessary railway facilities.

The Committee are now proceeding with the preparation of the programme for the forthcoming winter session, and they cordially invite offers of papers.

Mr. A. W. Martin has succeeded Mr. A. L. de Lattre as chairman, and the President has also been pleased to appoint Mr. J. M. Shackleton, late Metropolitan Engineer of the ex-Company, Vice-Chairman of the Centre.



Digitized by Google

## SCOTLAND EAST CENTRE.

A well-attended meeting was held on March 26th, at which an interesting paper on "Automatic Telephony" was read by Mr. J. Robertson, Assistant Engineer. The paper was illustrated by a number of lantern-slides, and a table telephone and a selector kindly lent by Messrs. Siemens Bros. were exhibited. A useful discussion followed, in which the various practical difficulties in applying the system to concrete cases were brought out. A hearty vote of thanks was accorded to the lecturer.

In the evening a successful whist drive and dance were held in the Carlton Hotel. An additional interest was lent to the occasion by the presence of the Engineer-in-Chief, Mr. W. Slingo, who, in a characteristic speech, introduced the prize-winners to Mrs. J. D. Taylor, who graciously presented the prizes.

Messrs. A. Eden and F. H. Machugh, former Superintending Engineers of this District, were also welcome members of the company.

---

## SCOTLAND WEST CENTRE.

The fourth meeting of the Session was held in March, when Mr. J. Hardie read a paper on "Some Notes on Underground Construction." The lecturer dealt principally with preliminaries in connection with underground schemes, *e.g.* development, selection and survey of routes, suitability of materials, supervision of contracts and cabling.

Attention was drawn to the desirability of having accurate forecasts of probable development, and in this connection Mr. Hardie thought that engineering officers were best qualified and in the most favourable position to carry out these studies.

A *résumé* was given of the advantages and disadvantages of the various classes of conduits, and it was considered that Sykes' ducts should not be laid in congested thoroughfares. Their use was recommended for country roads and the less busy streets, and then only when they were laid on a bed of concrete. Special attention was also drawn to the method of keeping diaries and checking contractors' accounts.

At the last meeting of the Session Mr. J. Richardson read a paper on "Subscribers' Circuits on C.B. Installations." The lecture was illustrated by very clear and neat diagrams, prepared by Mr. A. B. Riddell.

The lecturer described the principal features of the various classes of apparatus, including direct lines with extensions, small



Digitized by Google

C.B. switchboards, private branch exchanges, and cordless switchboards.

Reference was also made to the use of power-leads.

With the blue prints of the diagrams supplied the paper was favourably commented on as a suitable and convenient reference to put into the hands of fitters and others who may be dealing with this class of work, and it is understood that steps in this direction are being taken by some of the engineers concerned.

The annual general meeting of the Branch was held on May 12th, when the following committee for next session was elected: Mr. D. Stewart (chairman), Mr. J. Hardie (vice-chairman), Mr. W. Allan, Mr. J. Cameron, Mr. H. McCallum (librarian), and Mr. G. A. Struthers (local secretary).

Mention was made of the Engineer-in-Chief's reference to the desirability of electing committees without consideration being given to their official positions, and it was decided to recommend to the Council that the membership of the Institution should be extended.

At the conclusion of the business a hearty vote of thanks was given to Mr. R. A. Weaver, the retiring vice-chairman, and attention was drawn to the keen interest which he has taken in the affairs of the local branch.

## SOUTH LANCS. CENTRE.

The fourth meeting of the Session was held on March 3rd, seventy-five members and visitors being present. A paper was read by Mr. J. F. Fletcher on "Estimating by Sectional Engineers." The paper covered the preparation of estimates in the Sectional Engineer's office and also the method of preparing them for Headquarters in the Superintending Engineer's office. An animated and profitable discussion followed.

The fifth and last meeting of the Session was held on April 7th, thirty members and friends attending. A paper on "Engineering Materials" was read by Mr. W. B. Smith. The paper was illustrated by means of numerous samples supplied by various manufacturers. A good discussion followed.

## NORTH-EASTERN CENTRE.

The Session which has just closed has proved a most interesting one, as the following list of lectures will show:

1912.

October.—Mr. H. R. Kempe. "Reminiscences of the Telegraph," illustrated by lantern-slides.



Digitized by Google

November.—Mr. J. C. Butterfield. "Cash Accounting."

December.—Mr. G. H. Hoole. "Some recent Wayleave Decisions."

1913.

January.—Mr. W. Aitken, British Automatic Telephone Manufacturing Co., Liverpool. "Automatic Telephone," illustrated by lantern-slides and full model set of apparatus.

February.—Mr. P. A. Corney. "Some Notes on Correspondence."

March.—Mr. F. Addey. "Directive Wireless Telegraphy," illustrated by lantern-slides. Visit of Council.

March.—Mr. W. S. Tinsley. "Transfer of Local Exchanges."

„ Mr. S. A. Pickering. "Landlords and Tenants," from a wayleave point of view.

For the October, January and March (Mr. F. Addey) meetings, the engineering lecture-room at the Leeds University was kindly lent by the authorities, and there was an average attendance of 75, the highest attendance being at Mr. Aitken's meeting, when the total reached 111.

The visit of the Council was much enjoyed, and their thoughtfulness in providing the lecturer for the evening appreciated.

The discussions at the meetings have been very healthy and good information has been forthcoming by the expressions of opinion. Our meetings, as a matter of fact, are fast becoming the training-ground for lecturers, and by entering into the discussions many of our members have found that they are capable of "flights of oratory," and once having flown, are anxious to continue the exhilarating exercise.

The following officers have been elected for the new institutional year: Messrs. T. B. Johnson, A. Longden, W. S. Tinsley, G. M. Burton, J. C. Butterfield, G. H. Hoole.

## NORTH-WESTERN CENTRE.

A meeting was held in the Lecture Hall of the Preston Scientific Society on March 17th, when Mr. W. J. Finlayson read a paper on "Telephone Development." The various phases of the subject were exhaustively dealt with, and an animated discussion followed. The paper has been duplicated and distributed amongst the members.

A visit was paid to Messrs. Dick, Kerr, & Co.'s Electric Works, Preston, on April 7th. By the courtesy of the Works Manager (Mr. J. Conner), adequate arrangements were made for the party to be conducted round the different sections, where the many processes in the manufacture and assembling of electrical equipment were seen to full advantage. The members were also privileged to make a tour of the factory devoted to the manufacture of "Britannia" metal-



Digitized by Google

filament lamps. The various operations connected with the preparations of the filament, and the fitting together of the complete lamps, also their subsequent testing, packing in cartons, and despatch, were effectively demonstrated, and altogether the visit proved to be one of the most interesting of the Session.

The closing meeting of the 1912–13 Session was held on April 22nd, 1913, when Mr. J. Cooke contributed a paper on "Cash Accounts." There was a good attendance, and additional interest was added owing to the fact that this was the only paper devoted to a purely clerical subject which had been read during the present session. The whole of the procedure, from the point when the sectional pay-bill has been returned to the district office to its final state on presentation to the Accountant-General, was covered; special attention being devoted to the many details which, from time to time, cause confusion. Considerable discussion was provoked, and Mr. Cooke's offer to clear up any doubtful points connected with the cash account was taken full advantage of.

### Local Organisation, 1913–1914.

Mr. T. E. P. Stretche (*Chairman*), Mr. J. W. Sullivan *Vice-Chairman*), Messrs. S. Upton, A. W. Field, S. C. Leggett, and D. C. Savory (*Committee*), Mr. A. J. Ross (*Librarian*), Mr. D. Barratt (*Secretary*).

---

## NORTH-WESTERN DISTRICT.

### Annual Dinner.

The Annual Dinner of the North-Western District Staff was held at the Bull and Royal Hotel, Preston, on Tuesday, April 22nd, 1913, when upwards of seventy sat down to an excellent repast.

Mr. T. E. P. Stretche (Superintending Engineer) occupied the chair, and was supported by Mr. J. W. Sullivan (Assistant Superintending Engineer).

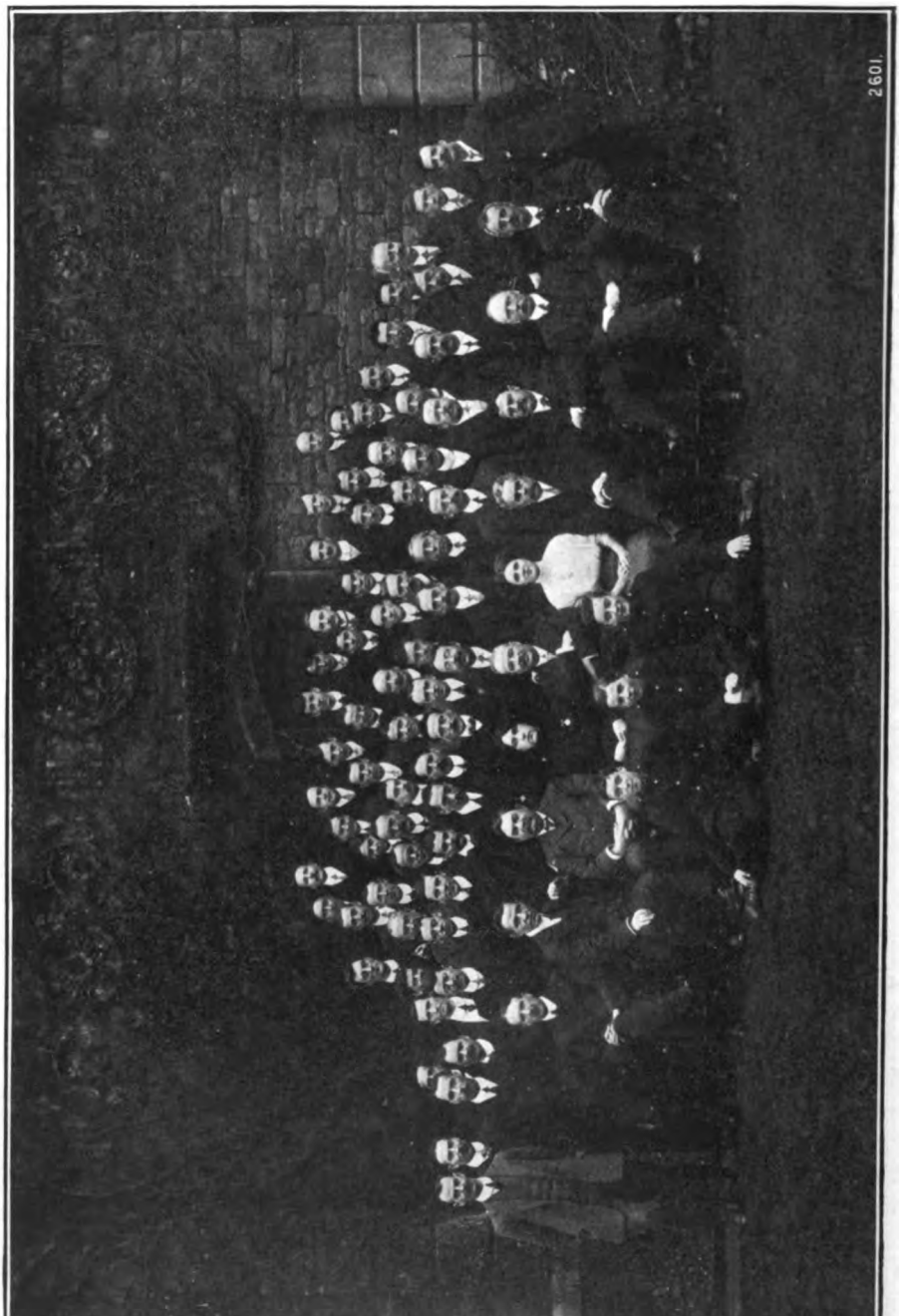
Letters of apology were received from Mr. R. O'C. N. Deane (Surveyor) and the Postmaster of Preston (Mr. T. H. Spraggon), who was unable to be present owing to indisposition.

The loyal toasts having been duly honoured, the toast of "The Visitors" was proposed by Mr. J. W. Sullivan, and responded to by Mr. A. C. Haley (District Manager, Telephones, Preston).

The toast of "The Chairman" was proposed by Mr. F. W. Best (Sectional Engineer, Oldham). Mr. Stretche, on rising was received with prolonged applause, and, in replying, referred to



Digitized by Google




SOUTH-WESTERN DISTRICT STAFF – BRISTOL.

*Front Line (sitting).*—A. W. Weir, E. Pink, A. T. Kinsey (Asst. Suptg. Engr.), Miss Jones, F. Tremain (Suptg. Engr.), Miss Elles, A. E. Chapman, C. G. Roach, J. Sheldon, G. W. Bannister.



Digitized by Google

the loyal support he had received from all sections of the Engineering Staff, which, as all present were aware, had been considerably augmented since the telephone transfer. Twelve months ago the total staff in the District numbered some 400 persons, whereas now that figure has been considerably more than doubled; and, as regards units of acquired plant, the District comes second in importance out of the whole of the provincial engineering districts in the Kingdom.

A musical programme of high order was contributed by Messrs. Barratt, Knowling, Dransfield, Atkinson, Adams, Field, Southgate, and Flannery.

The thanks of the staff to Mr. J. Cooke and the Committee (Messrs. Finlayson, Barratt, and Southgate), who so successfully arranged the gathering, and to the artistes, was voiced by the Chairman, and responded to by Mr. Knowling.

---

## NEW BOOKS.

'Baudôt Printing Telegraph System,' by H. W. Pendry, C.T.O. Pp. 144. 72 illustrations. (Whittaker & Co., 2, White Hart Street, E.C. 2*s.* 6*d.* net.)

Mr. Pendry's book is well printed and adequately illustrated, and provides a concise and comprehensive description of the system which our neighbours across the silver streak have brought to such a state of perfection. Mr. A. C. Booth's work in this connection receives the special attention which it so well merits.

'Toll Telephone Practice,' by J. Bernard Thiess, B.S., LL.B., and Guy A. Joy, B.E., with an introductory chapter by Frank F. Fowle, S.B. With 273 illustration. (Constable & Co., Ltd., 10, Orange Street, Leicester Square, W.C. 14*s.* net.)

It is an interesting feature of the art of telephony that every smallest variation in the conditions affecting the bringing of two subscribers into communication is reflected in some way in the design of the switching apparatus. In the case of long-distance telephony the fact that, generally speaking, each call has to be paid for separately, on a time basis, has necessitated variation from ordinary local switching conditions to such an extent that we now find toll or trunk switch practice acquiring a literature of its own.

In this book Messrs. Thiess and Joy have provided an exhaustive description of the methods which have been adopted in America for dealing with this class of telephone traffic.

Commencing with rural telephone equipment and cut-in stations



Digitized by Google

the various types of toll switchboard are described in great detail and with acceptable clearness. The diagrams are well drawn and well arranged, and there are a number of valuable tables. At a time when our trunk methods are passing under review the study of this treatise should be of value to Post Office engineers.

No less than five chapters are devoted to the subject of simultaneous telephony and telegraphy. We quote the opening paragraphs on this subject:

"The economy of wire plant which results from ability to transmit telephone and telegraph messages simultaneously over a single circuit is of the greatest importance commercially. The added cost of apparatus in systems for simultaneous transmission is insignificant compared with added revenue. Such apparatus has been used most extensively in toll systems, in which the derived telegraph circuits have been leased largely for private use.

"The demand in this country for private telegraph circuits, or leased lines as they are called, is considerable. They are employed by stock and grain brokers very extensively, and often by large industrial concerns who have offices or plants at different localities. They are also employed by wire companies themselves for the transmission of company business and sometimes as an aid in handling toll telephone traffic."

Progress of time seems only to emphasise the difference between American and British practice in this respect.

'American Telegraph Practice,' by Donald McNicol, A.M. (McGraw Hill Book Co., New York. Hill Publishing Co., 6 and 8, Bouverie St., London, E.C. Pp. 507. 421 illustrations. 17s. net.)

Mr. McNicol has aimed at providing a complete technical course in modern telegraphy as in use in America at the present day.

Beginning with a brief treatment of electricity and magnetism he gives details of primary and storage batteries, dynamos, motors, and other electrical machinery.

Circuits, switchboards, measuring apparatus, signalling systems, duplex and quadruplex telegraphy, etc., are adequately treated, and the subject of simultaneous telegraphy and telephony, which has received so much attention in America, is treated in a very thorough manner.

A single chapter is devoted to automatic and printing telegraphs, the writer's opinion of the latter being indicated by the statement that "although the subject of printing telegraphs is an old one with the inventor and with the promoter the development of satisfactory printing telegraph systems has not reached that stage where the subject is in shape for practical consideration in a work dealing with telegraph practice."



Digitized by Google

This sentence makes curious reading for Hughes and Baudôt experts.

The book is well printed and freely illustrated in the style of the McGraw Hill Co., which has become well known.

---

# STAFF CHANGES.

## POST OFFICE ENGINEERING DEPARTMENT.

### PROMOTIONS.

| Name. | Appointment. | | Date from which to take effect. |
|---|---|---|---|
| | Rank. | District. | |
| Medlyn, W. J. | Supt. Engr. | S. Lancs. | 1 : 6 : 13 |
| Taylor, J. D. | ,, | Sc. E. | 14 : 11 : 12 |
| Booth, A. C. | Staff Engr. | Telegraph Section | 14 : 2 : 13 |
| Shaughnessy, E. H. | ,, | Wireless Section | 14 : 2 : 13 |
| Cooke, A. E. | Prin. Clk. | London District | 18 : 2 : 13 |
| Renshaw, A. S. | Clk. 1st Class | E. in C.O. | To be fixed later. |
| McCormack, H. C. | ,, | S. Mid. | 22 : 4 : 13 |
| Macpherson, J. J. | Clk. 2nd Class | Ireland | 10 : 4 : 13 |
| Broadbridge, A. J. W. | Ch. Nav. Offr. | "Monarch" | 1 : 5 : 13 |
| Flowel, G. H. | ,, | "Alert" | 1 : 5 : 13 |
| Firmin, E. W. | 2nd Nav. Offr. | "Monarch" | 14 : 2 : 13 |

### TRANSFERS.

| Name. | Former. | | Present. | | Date from which to take effect. |
|---|---|---|---|---|---|
| | Rank. | District. | Rank. | District. | |
| Jackson, C. A. | Exec. Engr. | London | Exec. Engr. | N. Wa. | 22 : 4 : 13 |
| Beeton, H. G. | Asst. Engr. | Sc. W. | Asst. Engr. | E. in C.O. | 25 : 5 : 13 |
| Johnson, E. | Sub. Engr. | N. Wa. | Sub. Engr. | Sc. W. | 7 : 5 : 13 |
| Vaughan, G. H. | ,, | London | ,, | S. Lancs. | 25 : 5 : 13 |
| Lawson, R. | Proby. Engr. | ,, | Proby. Engr. | E. in C.O. | 16 : 6 : 13 |
| Riley, R. | 2nd Cl. Clk. | E. L. and P. | 2nd Cl. Clk. | S. Mid. | 13 : 5 : 13 |
| Cousins, E. W. | ,, | London | ,, | E. L. and P. | ,, |
| Peck, H. W. | 3rd Cl. Clk. | E. | 3rd Cl. Clk. | S. Mid. | 1 : 5 : 13 |
| Hill, H. | ,, | E. | ,, | E. in C.O. | 4 : 5 : 13 |
| Thompson, J. T. | ,, | N. | ,, | S. Mid. | 2 : 6 : 13 |
| Pethurst, A. E. | ,, | London | ,, | E. | 18 : 5 : 13 |
| Jackson, R. | ,, | E. | ,, | London | ,, |
| Apted, P. F. | ,, | E. in C.O. | ,, | S.O. | 4 : 5 : 13 |
| Pearce, F. J. | ,, | ,, | ,, | ,, | ,, |
| Colyer, G. W. | ,, | ,, | ,, | ,, | 1 : 2 : 13 |



Digitized by Google

RETIREMENTS.

| Name. | Former. | | Particulars. | Date from which to take effect. |
|---|---|---|---|---|
| | Rank. | District. | | |
| Groves, J. W. | Supt. Engr. | S. Lancs. | Superannuated | 31 : 5 : 13 |
| Rivers-Moore, H. R. | Asst. Engr. | E. in C.O. | Resigned | 6 : 6 : 13 |
| Wrake, J. | Navg. Commander | "Monarch" | Superannuated | 1 : 5 : 13 |
| Wightwick, O. | 3rd Cl. Clk. | N.W. | Promoted 2nd Divis. Clk. Nat. Health Insurance Com. | 9 : 2 : 13 |

DEATHS.

| Name. | Rank. | District. | Date. |
|---|---|---|---|
| Raper, T. H. | 1st Cl. Clk. | N. | 9 : 5 : 13 |
| Paterson, W. | Chief Engr. | "Monarch" | 6 : 4 : 13 |

# A PERSONAL NOTE.

With this issue—my twenty-second—my duties as Managing Editor are terminated. I have much enjoyed the work, and have taken pleasure in the success of the JOURNAL. I take this opportunity to sincerely thank all those officers, editors, authors and agents whose willing aid and hearty co-operation have made that success possible.

D. H. KENNEDY.

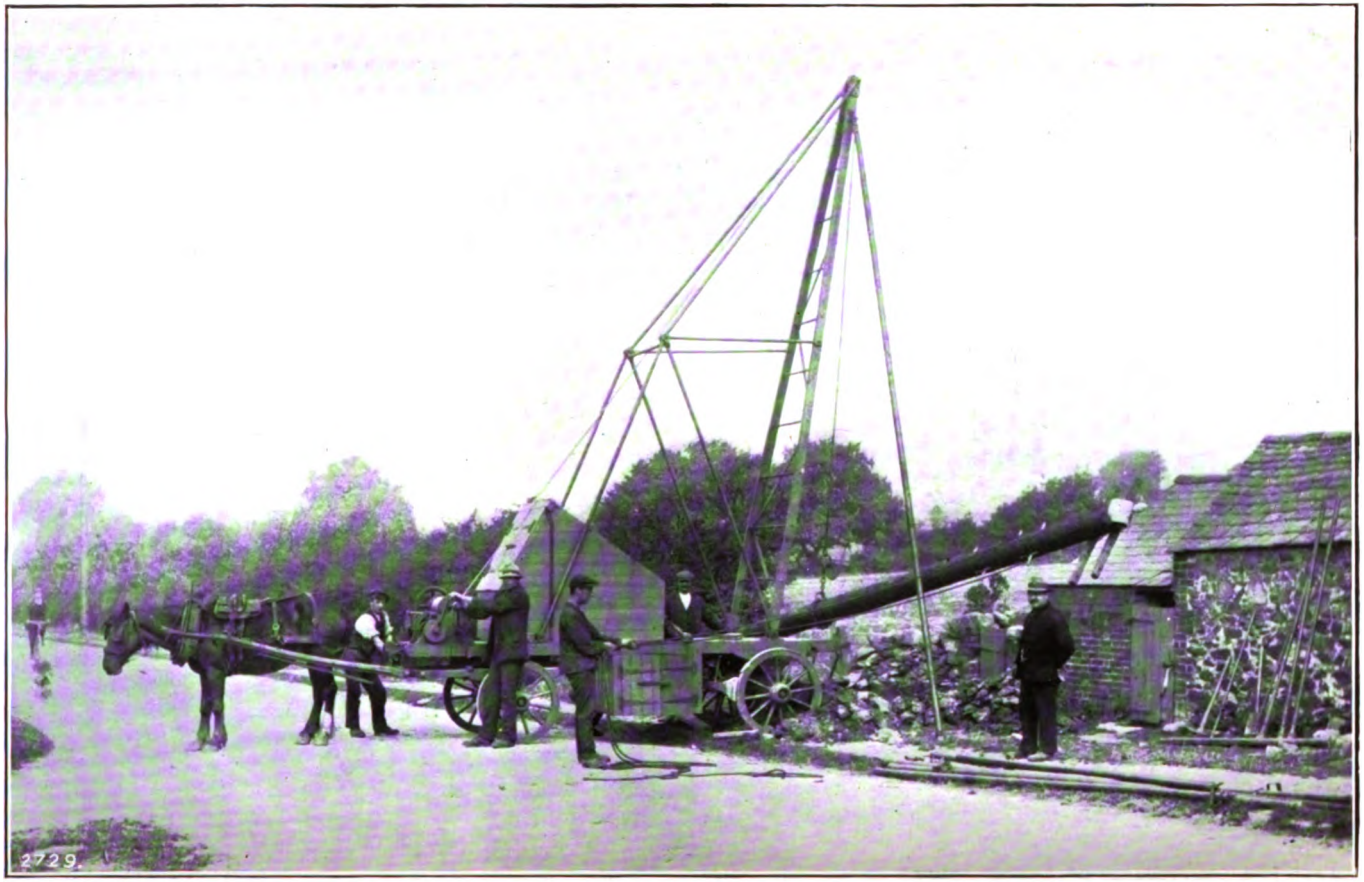
## COMMUNICATIONS.

All Remittances and Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, G.P.O. West, London, E.C.



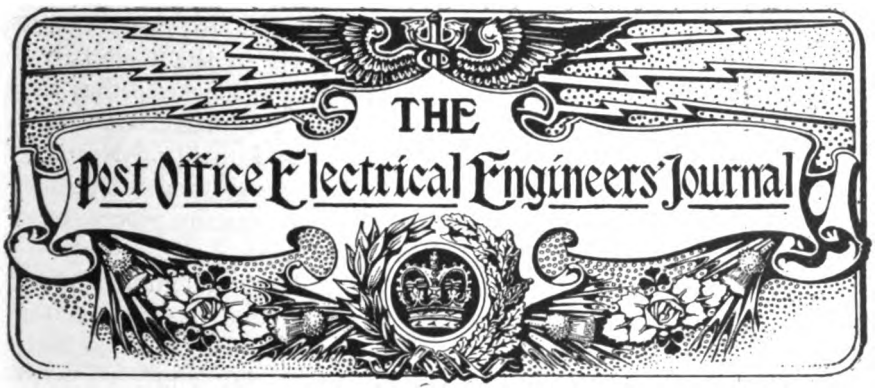
Digitized by Google

Digitized by Google




Pole Derrick Wagon at Work on New Main Route, Leicester to Derby.

Digitized by Google




# THE TELEPHONE ARBITRATION.

By J. W. W.

MOST of those now in the service have personal knowledge or have heard about the important events which concluded with the telephone arbitration of 1912. First, the Edison judgment which declared that a telephone was a telegraph within the meaning of the telegraph acts and, therefore, within the Postmaster-General's telegraphic monopoly, and which defined that monopoly as covering any system of signalling by wire, whether worked by the agency of electricity or not, and any system of electric signalling, whether utilising a wire or not. Secondly, the restricted licences of 1881, which only allowed licensed companies to work within a defined radius of certain towns. Thirdly, the unrestricted licenses of 1884 which practically allowed licensed companies to provide telephonic facilities without restriction as regards territory. Fourthly, the purchase of the trunk wires by the Post Office in 1896, and the limitation of the powers of the National Telephone Company, that had by this time absorbed the other licensed companies, to certain areas which were apparently defined in somewhat haphazard way. Fifthly, the Telegraph Act, 1899, which provided for competition between the Post Office and the National Telephone Company in London and allowed municipalities to compete in the provinces. Sixthly, the London agreement of November 18th, 1901, which arranged for co-operative working between the National Telephone Company and the Post Office in London, and for the purchase on tramway terms of the Company's plant and assets in London on December 31st, 1911. Seventhly, the purchase agreement of February 2nd, 1905,



Digitized by Google

which provided for the purchase of the remainder of the Company's plant and assets on similar terms, except that goodwill was payable in the case of private wires and certain competitive systems. Eighthly, the preliminary proceedings of last year, when the Post Office notices of objection to purchase certain parts of the Company's system were dealt with, and the Court of Appeal declared that the term "unsuitable for the purposes of the Postmaster-General's telephonic service" referred to both quantity and quality. Ninthly, the transfer of the National Telephone Company's system to the State on December 31st, 1911. And tenthly, the arbitration proceedings of 1912.

On Monday, June 10th, the telephone arbitration commenced in real earnest, although before that date there had been what our athletic readers would call two qualifying rounds, during which both parties expressed their eagerness to name the day, and each with equal cleverness endeavoured to postpone it and to throw the onus of postponement on the other.

The Court of the Railway and Canal Commission, which tribunal adjudicated on the value of the National Telephone Company's plant and assets, was composed of Mr. Justice A. T. Lawrence, The Hon. A. E. Gathorne-Hardy, and Sir James Woodhouse.

Sir Alfred Cripps, K.C., Mr. Danckwerts, K.C., Mr. Forbes Lankester, K.C., Mr. Morton, K.C., Mr. Gaine and Mr. Aubrey Lawrence represented the National Telephone Company; and the Attorney-General (The Right Hon. Sir Rufus Isaacs, K.C.), the Solicitor-General (Sir John Simon, K.C.), Mr. Buckmaster, K.C., Mr. Rowlatt, and Mr. Branson represented the Postmaster-General. Mr. Schwabe took Mr. Rowlatt's place when the latter was appointed a Judge of the King's Bench.

The National Telephone Company claimed from the Postmaster-General the sum of £20,924,700 as the amount of the purchase money payable to them for their plant, property, and assets under the Purchase Agreement of 1905. The particulars of the claim were filed as follows:

| | |
|---|---|
| I. Inventoried plant not specially mentioned below (£17,047,269), less plant recovered since completion of inventory (£311,443) . | £16,735,826 |
| Ia. Cost of obtaining subscribers' agreements . | 643,370 |
| II. Plant included in the notices of objection of last year and subject to an agreed deduction for special depreciation . . | 120,953 |
| III. Plant provided under Joint Purse Schemes (Company's share) . . . . . | 89,140 |
| IV. Plant as to which there was a difference whether or no it was proper to heading II | 42,317 |



Digitized by Google

| | |
|---|---|
| V. Plant provided since completion of inventory | 658,599 |
| VI. Printing plant at Telephone House, and machinery, etc., at Nottingham and Dalston | 7,592 |
| VII. Books, forms and records; stationery, maps, and books of reference; correspondence and investigations; service instructions; directory | 181,108 |
| VIII. Land and buildings, including wayleaves and structural alterations and additions in the case of rented premises | 1,499,786 |
| IX. Goodwill at Portsmouth, Brighton, and Hull | 211,372 |
| X. Goodwill on private wire business | 212,350 |
| XI. Stores and tools | 434,747 |
| XII. Furniture, fittings and fixtures | 87,540 |
| Total | £20,924,700 |

The Postmaster-General, generally speaking, agreed to the quantities as regards plant but denied the values which were assigned to them. He also agreed to the price as regards the printing plant and machinery (heading VI); but he denied any liability in respect of headings Nos. I*a* and VII and of goodwill for the system at Hull.

In opening the case for the National Telephone Company, Sir Alfred Cripps confined his attention chiefly to the first seven headings and practically the evidence up to the adjournment was devoted to headings Nos. I and I*a*. He called as witnesses:

Mr. Gill, Engineer-in-Chief; Mr. Cook, Assistant Engineer-in-Chief; Mr. Goddard, General Superintendent; Mr. Anns, Secretary; and Mr. Weston, General Superintendent's office, of the National Telephone Company. Sir Alexander Kennedy. Mr. Swinburne. Sir William Plender, President of the Institute of Chartered Accountants. Mr. Butterworth, General Manager, North-Eastern Railway. Sir W. G. Granet, General Manager, Midland Railway.

The main features of the Company's case as developed in evidence were as follows:

(*a*) A peculiar interpretation of tramway terms.

(*b*) The method in which the unit costs were arrived at.

(*c*) The method of depreciation.

(*d*) The lengthy lives ascribed to the various items of plant.

(a) *Tramway terms.*—Sir Alfred Cripps argued that the value on tramway terms was the cost of replacement, less depreciation, and that the cost of replacement should be the cost to which the Company



Digitized by Google

had been put in providing the plant. In other words, he based his costs on the value of the system *to the seller*. He urged that the special clause in the purchase agreement which referred to the value having regard to its suitability for the purposes of the Postmaster-General's telephonic service had in view, not a depreciation, but an appreciation of the value of the Company's plant and assets. Inasmuch as no item for appreciation appears in the Company's claim, this suggestion was probably not even made seriously.

(b) *Unit costs.*—The Company's unit costs were prepared on the assumption that the whole system would take twelve years to construct, one sixth of it being constructed in two years and the construction gangs being then transferred to another section. The method of calculating the unit costs may be fairly realised from a study of the sample sheet, dealing with the unit cost of one mile of 3-inch cast iron pipe (including wood plugs, draw wire and split pipes) (see Table 1). Similar statements were presented showing the unit cost of a mile of cement duct, underground cable, aërial cable, bare wire, etc.

In order to arrive at the total cost of material, the cost of the material at the suppliers was averaged on the cost to the Company over a period of eleven years, and to the amount so arrived at were added (1) the cost of haulage from the suppliers to the distributing centre and from the distributing centre to the place concerned, (2) the cost of cartage to the work, and (3) the cost of wastage. In item numbered 5 the actual cost of burial was taken, and then various percentages for every conceivable contingency were added separately, either to the cost of labour only, or to the total cost of labour and material to the point at which the percentage was applied. Most of the other items are self-explanatory, but it should, perhaps, be pointed out that, as the resultant unit cost was to be applied to the gross total of inventoried plant wherever situated, an addition was made to item 5 so as to raise the unit cost to a figure which would cover, by application to the whole, the extra cost of work in London.

(c) *Sinking fund method of depreciation.* — Sir Alfred Cripps introduced a new method of calculating the depreciated value of plant, in order, as he said, to make the purchase price equally fair to the buyer and the seller. For this purpose he introduced a set of tables showing, in parallel columns, for a period of twenty years:

(1) The interest on an assumed capital at 5 per cent;

(2) The sinking fund payment which would be necessary to recover the amount at the end of the given life with 5 per cent. interest;

(3) The sum of Nos. 1 and 2;

(4) The accumulated total of the sinking fund year by year; and

(5) The amount still to be redeemed year by year.



Digitized by Google

He argued that so long as No. 3 remained constant the burden on the undertaking was equally spread over the whole period of years, and that the purchase price at any particular time was the amount shown in column No. 5 as the amount of capital still to be redeemed at that time. For example, in the case of plant, with no residual value and a life of twenty years, costing £100, the seller at the end of ten years would receive from the buyer £62. Sir Alfred Cripps urged that, although the buyer at that price would have to pay more to the sinking fund in order to recover £62 in ten years, he would pay a correspondingly less amount as interest on the smaller capital which he had invested in the business. The Company's witnesses supported the argument, but on cross-examination they admitted that the sinking fund calculations had never previously been used in this way in "tramway valuations," and they could quote no instance of their application to everyday sales.

(d) *Life.*—Sir Alfred Cripps and his witnesses claimed that the life which ought to be taken for the purposes of valuation was not what was at various times referred to as "practical life," "actual life," or "working life," but was "the physical life." Physical life was defined by Mr. Gill in evidence as "practical life" under constant conditions, disregarding any changes other than those due to physical decay. On this basis the Company claimed the undermentioned lives for the main items of plant specified below, viz.:

| | | | |
|---|---|---|---|
| Iron pipes . . . | 80 years | Creosoted poles . | 45 years |
| Cement blocks . . | 80 ,, | Bronze wire (40 lb.) . | 22 ,, |
| Cable (L.C.P.C.) . | 70 ,, | Copper wire (100 lb.) | 42 ,, |
| Cable (V.I.R.), aërial | 20 ,, | Subscribers' apparatus | 25 ,, |

Exchange equipment from 2·5 years for cords to 30 years for bulk of equipment.

Mr. Gill was the principal witness on behalf of the National Telephone Company; and he piloted the Court through the Company's numerous statements of unit costs with great skill and patience. The actual detail as regards the statements in respect of subscribers' apparatus and exchange equipments was dealt with by Mr. Cook. It soon became evident during the examination in chief of Mr. Gill that the figures, and percentages especially, in the Company's statement would need close and careful analysis on behalf of the Post Office. These figures were, with one or two exceptions, based on figures taken from the Company's books for a period of a month, a twelvemonth, or the whole period of eleven years; and access to the Company's books was granted to the Post Office for the purpose of checking the calculations. The exceptions were based upon experience and general practice, and were as follows: Head Office engineering 5 per cent., contingencies 2 per cent.,



Digitized by Google

contractors' profits 10 per cent., and, where no book record was available, some of the component parts of the various percentages.

In the course of the cross-examination by the Solicitor-General and Mr. Buckmaster, the method of calculation of certain of the items was criticised, and an endeavour was made to prove that the figures were inaccurate. The Company's counsel accepted the view that the freight charges required adjustment, and that the percentages (such as those for ordering and storing material), which were based upon certain figures produced from the Company's books, were not correct. It is of interest to note that the error in some of these cases arose through the not unnatural method of entering nett credits in the books instead of making separate entries for the cost of labour in recovering the stores and the value of the stores recovered.

When the Solicitor-General opened the case for the Post Office he made a brilliant speech, which was clear, closely argued, and an intellectual treat from beginning to end. Naturally, a large part of it was devoted to a destructive criticism of the Company's methods and tables; but, before proceeding to that part of his speech, he claimed that the proper interpretation of "tramway terms" in this case was, not the cost of the system to the *seller*, but the cost which the *buyer* would incur in replacing it, less depreciation by the recognised methods. He repudiated altogether the Company's "sinking fund" method of depreciation on the grounds, *inter alia*, (1) that sinking fund calculations were part of a financial arrangement for spreading costs equally over a period of years, irrespective of the engineering conditions; (2) that on the Company's method, the value of the plant at any particular time depended on the rate of interest at which the money could be raised and invested; and (3) that, while the vendor had the certainty of a past life for the plant during his time of ownership, the seller took the uncertainty of a future life with its attendant risks. He urged that the "straight line" method of depreciation had always been adopted in cases of valuations on tramway terms. He also declared that the practical and not the physical life of the plant ought to be taken into account, and that such items as the cost of raising capital were proper to revenue and not construction.

The Solicitor-General then attacked the Company's claim in general and in detail, and drew attention to the following points which he regarded as the weaknesses of their method, viz.:

(1) That the method of percentages necessarily gave two opportunities for error, because a percentage was of the nature of a vulgar fraction, and, if either the numerator or the denominator of the fraction was wrong, the resulting percentage was inaccurate. He claimed that he had proved in evidence wherever a check had been made that the numerators used by the Company were too large and the denomi-



Digitized by Google

nators were too small, and that the consequence in the case of both errors was to make the percentage larger than it ought to be.

(2) That a further risk of error arose where there was not a constant and logical ratio between the numerator and denominator of the fraction, and he exemplified this by reference to a figure which had been used by the Company as the expenditure for a composite year of 1909–1910, and which was less than their average yearly expenditure for the last six years.

(3) That for some purposes the Company had made calculations with a view to the separation of construction expenses and maintenance expenses, and for others had made no attempt at such division.

(4) That, although the claim was put forward as though it was based on the Company's books, they did not appear to make use of such figures as they had in their books. He illustrated this by pointing out that for ordinary commercial purposes the Company separated in their books the expenses on construction from the expenses on maintenance, and yet they made a fresh division for the purpose of the valuation.

(5) That adjustments had been found necessary in the figures for the composite year, but no attempt had been made to correct exactly similar errors in other parts of the tables.

(6) That sometimes the costs were based on ascertained fact and in others on estimates, and some confusion arose between the two points of view. For instance, he mentioned that a charge for contingencies could not be justified if the cost represented the actual cost of the work to the Company.

(7) That a percentage of 5·5 on the total expenditure for construction and maintenance was obtained by calculation from the books, and after many transmutations appeared in the tables as two separate percentages of 5 and 5·838 for Head Office supervision.

(8) That no consistent line was drawn between the place where the contractors' work ended and the place where the employers' work began.

(9) That the Company's costs, being based on their piecemeal construction during many years, affected original prices and the percentages adversely to the Post Office.

(10) That the Company, instead of making a deduction for piecemeal construction, claimed to make additions on the ground that the cost of construction would have been more if it had not been for the existence side by side of an organisation for maintenance purposes.

(11) That the whole system of percentages is so artificial and so difficult to check as to be no safe guide to the Court. He pointed out certain instances of want of internal cohesion between the various tables.

(12) That the percentages were cumulative, and that any error in



Digitized by Google

the earlier parts of a table increased, like a snowball, before it reached the total.

In these circumstances the Solicitor-General said that he had no hesitation in presenting to the Court an alternative scheme of valuation which had been prepared by the Post Office. This scheme was, he said, based upon the assumption that the whole work of replacement would be carried out by contract, and that the usual consulting engineer's charges of 5 per cent. only would be charged for planning and supervision; and he hoped to show to the Court that his prices covered everything from beginning to end, or, as Mr. Gathorne-Hardy expressed it, "from the cradle to the grave." He produced a large printed book which contained the summary of each of the various calculations in respect of the various types of equipment, and separate detailed books for conduits, cables, bare wire, aërial cable, etc. These tables had been prepared in such a way as to facilitate reference from the summary to the relative detailed calculations; a sample page of the summary is enclosed. It will be seen that each item of cost had two columns, the first column showing the section and page where the detailed calculations would be found and the second the amount in money. Mr. Snell, a partner in the firm of Messrs. Preece, Cardew & Snell, was the first witness on behalf of the Post Office, and he undertook the task of expounding the Post Office tables to the Court. I propose to follow the item of one three-inch cast-iron pipe through the tables in order to show the detail which was included in the various subsidiary tables, and to quote in each case the index number of the section concerned. (See Table II.)

*C.M. 2: Material.*—The price was taken at £121 per mile, and a contract placed by the Post Office on December 21st, 1911, was quoted as corroborative evidence. No reduction of price was made on the ground of the heavier weight of Post Office pipes. Delivery, free on rail.

*C.S.* 1: *Splits and bends.*—Cost based on specified contract and various additions made to cover freight, and contractors' charges to completion, including permanent reinstatement.

*C.F.* 2: *Freight.*—Rates to each of the agreed sixty-eight centres were obtained from the railway companies for conveyance from the most likely sources of supply and an equated average cost per ton was calculated.

As the result of an inquiry by Sir Alfred Cripps, the freight rates were re-calculated for three selected centres on the basis of the actual places where the pipes were laid. It was found that this re-calculation resulted in an increase of 4·7 per cent. on the freight charges for these three centres, but a much greater decrease from the amount claimed by the Company.



Digitized by Google

Freight from the railway station to the work is covered by the Post Office contracts mentioned in the next heading.

*C.E.* 8: *Excavation; and D, reinstatement.*—The whole of the Post Office contracts for 1911 were examined and an average price for each type of surface was calculated. In this particular case the permanent reinstatement charges were included. In the case of the Post Office contracts, prices were tendered by contractors for each type of work, whether the actual work involved that type or not. In cross-examination, Sir Alfred Cripps pointed out that a contractor was likely to tender at a false price for work that he was not required to do, and he endeavoured to show that the great differences in the Post Office prices for the same kind of work was due to that possibility. It was found, however, that in the case of the one cast-iron pipe, if the contracts which did not cover the laying of one pipe were excluded, the average prices for laying would have been less than those adopted by the Post Office.

*C.P.* 1: *Extras.*—These items included abandoned pilot holes, abandoned trench, tunnelling, diversion of other parties' plant, brick and concrete piers, repairs to cellars, etc., timber for shoring, concrete for protection, wrought iron boiler plate, etc. These figures were based upon an analysis of all the Post Office contracts during a period of ten years covering work in the outer London area.

*C.P.* 2: *Petty materials.*—One per cent. was added to cover these various items, as a matter of judgment.

Five per cent. was added to the total cost obtained from the various summaries to cover the charges of a consulting engineer for designing, supervision of the contracts, etc.

On the question of life, Mr. Snell gave the following evidence, viz.:

| Article. | Physical life. | Practical life. |
|---|---|---|
| Cast-iron pipes . . . | 60 years . | 40 years. |
| Cement blocks . . . | 80 ,, . | 20 ,, |
| Cables underground . . | 50 ,, . | 20 ,, |
| Aërial cable (V.I.R.) . . | — ,, . | 12·5 ,, |
| Creosoted poles . . . | 27·25 ,, . | 20·5 ,, |
| Bare wire (equated life) . | — . | 8·5 ,, |
| Subscribers' apparatus . . | — . | 9·5 ,, |
| Exchange equipment (equated life) . . . | — . | 12·4 ,, |

And he claimed that, so far as regards the practical life of the bare wire and subscribers' apparatus was concerned, the figures were obtained from the statistics supplied by the Company in support of their claim as regards the age of the existing plant.

At the close of his evidence in chief Mr. Snell handed in the



Digitized by Google

following statement, which shows how the Company's claim compared with the alternative valuation of the Post Office.

*Heading I of Company's claim.*

| | Cost of construction. | | Valuation. | |
|---|---|---|---|---|
| | Company. | G.P.O. | Company. | G.P.O. |
| | £ | £ | £ | £ |
| Conduits | 2,839,742 | 1,441,093 | 2,790,821 | 1,064,731 |
| Cables | 3,337,353 | 1,962,659 | 3,186,582 | 1,446,391 |
| Poles and standards | 2,614,781 | 1,662,982 | 2,166,489 | 812,006 |
| Bare wire | 3,343,370 | 2,139,702 | 2,994,801 | 1,232,977 |
| Aërial cables | 1,017,261 | 497,987 | 692,355 | 213,569 |
| Exchange equipment | 2,641,640 | 1,505,131 | 2,297,598 | 692,360 |
| Glasgow exchange | | 37,882 | | |
| Subscribers' apparatus | 3,756,168 | 2,369,730 | 2,918,563 | 1,545,817 |
| £ | 19,550,315 | 11,617,166 | 17,047,269 | 7,005,851 |

In the course of the cross-examination of Mr. Snell, Sir Alfred Cripps called attention to one or two other points in the Post Office tables concerning which further information was required. Discussion as regards them was left over until the re-assembling of the Court on October 15th. An order was made by the consent of the parties on July 16th for the payment of a further sum of £4,000,000 on account. This sum, with the £3,000,000 paid at the date of the transfer and the balance of prepaid subscriptions, etc., remaining in the hands of the Telephone Company, made a very large payment on account.

When the Court resumed its labours after the Long Vacation, the leading Counsel announced, to the manifest delight of the Court, that during the Vacation an agreement had been arrived at between the parties in respect of the fundamental cost of construction under Heading I, *i. e.* the cost of material, freight, labour (up to the gang foremen) and casualty insurance, and that consequently the issues to be decided by the Court were confined to the additions which ought to be made to the fundamental cost in order to arrive at the cost of construction, the ages and lives of the plant, and the method of depreciation. The result of this arrangement was that the Court were enabled to jettison much of the literature of both parties, which had been handed to them during the earlier stages of the case, and could confine their attention to smaller summaries which were based upon the agreed figures. The Company's summary was not materially different from the specimen shown in Table I.

The Post Office statements were in the following form, viz.:



Digitized by Google

*Heading I.*

(1) (*a*) Conduits.

| | £ | £ |
|---|---|---|
| Agreed cost of: | | |
| (*a*) Material at suppliers, manufacturers' profits, and wastage | 466,142 | |
| (*b*) Freight (including cartage from suppliers to site) | 40,746 | |
| (*c*) Wages and expenses up to and including gang foremen, tools and sundries | 716,888 | |
| (*d*) Casualty insurance | 10,753 | |
| | | 1,234,529 |
| Add: | | |
| Cost of contractors' supervision and administration, 21 per cent. on item (*c*) | | 150,546 |
| | | 1,385,075 |
| *Contractors' profits, 10 per cent. on £1,385,075 | | 138,507 |
| | | 1,523,582 |
| Consulting engineer's fee, 5 per cent. | | 76,179 |
| Total | | £1,599,761 |

After the presentation of the revised documents, the cross-examination of Mr. Snell was resumed. The Solicitor-General then called the following witnesses in the order mentioned in support of the Post Office case, viz.:

Mr. G. H. Nisbett, Engineer and Manager of the British Insulated and Helsby Cables, Ltd.; Mr. W. Slingo, Engineer-in-Chief of the Post Office; Mr. J. O. Callender, of Messrs. Callender's Cable and Construction Company, Ltd.; Prof. D. C. Jackson, of Boston, U.S.A.; Mr. A. Siemens, of Messrs. Siemens Bros. and Co., Ltd.; Mr. G. W. Hook, formerly Superintending Engineer of the South Midland District; Mr. W. Aitken, of the Automatic Telephone Manufacturing Co., Ltd.; Mr. S. G. Leech, of Messrs. Saunders and Co. Ltd., constructional engineers; Mr. Andrew Young, Valuer to the London County Council; Mr. A. M. J. Ogilvie, Third Secretary to the Post Office; Sir William Peat, chartered accountant; Mr. P. W. Leake, chartered accountant; Sir Hugh Bell, of Bell Bros., ironmasters and colliery owners of Middlesborough, Dorman, Long and Co., North-Eastern Steel Co., North-Eastern Railway Co.; Sir George Gibb, formerly Solicitor and General Manager of the North-

* In the case of cable and internal equipment, where the work of laying or erecting can be carried out by the same contractor who supplies the material, the contractors' profits were calculated on items *b*, *c* (+ 21 per cent.) and *d*, on the ground that a manufacturer would not ask for two profits and the manufacturers' profit was included in item *a*.



Digitized by Google

Eastern Railway Co., and now Chairman of the Highways Board Mr. E. Williams, of the Engineer-in-Chief's office; Mr. H. Sparkes, of the Stores Department; Sir John Gavey, C.B., formerly Engineer-in-Chief of the Post Office.

Mr. Nisbett, Mr. Callender, Professor Jackson, Mr. Siemens, Mr. Aitken, Mr. S. G. Leech and Sir George Gibb gave evidence to the effect that, given the agreed fundamental cost, 21 per cent. on the cost of labour was a proper and sufficient allowance for contractors' supervision, that 10 per cent. was the maximum amount ever added for contractor's profit, and that such addition was not made in the case of material which was manufactured by the contractor by whom the installation was carried out. Mr. Slingo gave general evidence in support of Mr. Snell, and had to bear the weight of severe cross-examination concerning negotiations and contracts with the National Telephone Company which had been entered into before his transfer to London, and to explain and defend certain North Wales statistics which were put forward by the Post Office as corroborative evidence in support of the percentage added for contractors' supervision. He had also to bear the brunt of an attack by Sir Alfred Cripps on the Post Office system of valuation, which Sir Alfred urged repeatedly was based upon fiction, *i.e.* on costs of a hypothetical contractor, whereas the Post Office had it in its power to produce facts in the shape of actual Post Office experience of the cost of constructing its own telegraph and telephone systems. It was pointed out by Mr. Slingo and by Sir John Gavey that the Post Office methods of construction differed so materially from those of the National Telephone Company that in many respects the cost to the Post Office of its system was most unreliable as a gauge of the value of the National Telephone Company's system.

Mr. G. W. Hook gave evidence solely as regards the faulty condition of the cement ducts. Mr. Andrew Young, who has certainly had unique experience of valuations on tramway terms, gave general support to the method of valuation adopted by the Post Office, to the straight-line method of depreciation, and to the sufficiency of an addition of 5 per cent. to meet all the employers' burthens in connection with construction. Mr. Ogilvie gave evidence as regards the negotiations between the National Telephone Company and the Post Office for the provision of underground wires by the Post Office on rental terms, and at the request of the Court produced a copy of the whole correspondence, including a copy of a report—dated January 17th, 1906—from Mr. Gill to the then General Manager of the National Telephone Company. In this latter report it was made clear that Mr. Gill considered at that time that the capital value of underground work was works order



Digitized by Google

cost plus 15 per cent. for supervision. This report seemed to create considerable impression on the Court. Mr. Ogilvie also dealt in evidence with the Company's claims for the cost of raising capital, cost of obtaining subscribers' agreements and Head Office expenditure, and he produced and proved certain figures showing the cost per station of the Post Office system.

Sir William Peat, Mr. Leake and Sir Hugh Bell upheld the views that the depreciation of plant could not in a case of this kind be dealt with by a sinking-fund method, and that depreciation must be spread evenly over the life of the plant, although, for accounting purposes and as a matter of finance only, a sinking arrangement was a suitable means of providing the funds to meet depreciation.

Mr. E. Williams gave evidence as regards the analysis of the Company's books for the purpose of arriving at the various percentages based on the expenditure and allocation of expenditure for a composite year.

Mr. H. Sparkes explained the Post Office arrangements for ordering and storing material.

The Attorney-General and Sir Alfred Cripps had, during the recess and while the case was being conducted, been in negotiation with a view to shorten the proceedings before the Court as much as possible; and on December 9th, the seventieth day of the proceedings, they announced that an agreement had been arrived at as regards headings V to XII of the claim, and that the result of such agreement was to reduce the total represented in the claim as £3,293,094 to £2,055,468.

The Solicitor-General, in his closing speech, which lasted twelve days, pointed out that the settlement of fundamental cost disposed of many questions which had in an earlier part of the proceedings been treated as matters of great importance. For instance, he pointed out that the actual instant at which the valuation should in theory be made and the economic period of construction were now of academical interest only. He expressed his willingness to accept the Company's claim, that "interest during construction" should properly be added to the costs of construction; and he then proceeded in much detail and with frequent references to the evidence to attack the Company's claim on the general lines indicated in his opening speech. He pointed out amongst other things (1) that the fractions on which the charges for Local Administration and Engineering were based were even now obviously inaccurate, because the numerator, when divided into the total claim under that heading, showed that the constructional work of the whole of the Company's system, if carried out at the same rate, would take twenty years to complete, while the denominator, being only one seventeenth of the alleged cost of construction, showed that the period of con-



Digitized by Google

struction ought to be seventeen years; and (2) that since the agreement as regards fundamental cost the Company had added to their claim an item for sub-contractors charges in justification of which no satisfying evidence had been given. He summed the evidence on behalf of the Post-Office case and then put forward what he termed a series of checks, which, although not each in itself conclusive, were, when taken together, in his opinion conclusive proof that the Post Office valuation was more to be relied upon than that of the Company. The first of these checks was the cost per station of the systems purchased from the Glasgow and Brighton Corporations and of the Post Office system after allowances were made for the material differences between the Post Office method of construction and that adopted by the Company. Then he called attention to the report of the Company's Engineer-in-Chief, which was laid before the Court by Mr. Ogilvie; and finally he pointed out that the Company's total expenditure on capital account fell far short of the amount which they claimed. He argued the question of physical *versus* practical life, and suggested that the life of plant must mean the time which in ordinary course it would remain *in situ*, that the time it remained *in situ* depended on economic conditions as well as on physical decay, and urged that in fixing the life the Court ought to make proper allowances, for obsolescence, decay, overloading, alterations of route, etc., so as to give effect to the condition of the purchase agreement, which provides that the value of the Company's plant and assets must be arrived at having regard to their suitability for the Postmaster General's telephonic business.

In discussing the cost of obtaining subscribers' agreements, he claimed that no addition ought to be made to the cost of construction for such work because it was necessarily undertaken for revenue purposes, that, inasmuch as the Company obtained many wayleaves from their subscribers without payment, the amount claimed was excessive, that no allowance had been made for cessations, age, etc., that the rates of subscription affected cost of canvassing, that the Company in their "Commercial Handbook" gave the object of canvassing as the obtaining of revenue, and that the Post Office would be entitled to appeal against any award under this heading as a point of law. At the invitation of the Court, who apparently thought at first that the cost of raising capital was a revenue and not a capital charge and subsequently changed their minds, the Solicitor-General argued that the cost of raising capital did not increase the value of property, because otherwise the value of similar plant would be more to the man of little financial standing than to the rich man, and less to the man who paid a high rate of interest than to the one who paid a small rate of interest. He also claimed that any award on this question would be open to appeal.



Digitized by Google

On the question of the sinking fund method of depreciation, he pointed out that not even the Company's own witnesses could quote any case where that method had been adopted as between a buyer and a seller.

Sir Alfred Cripps followed the Solicitor-General and also spoke twelve days. As counsel for the claimants he had the final word, and this fact gave him considerable advantage, more especially in the last few days, when, tired with his prolonged effort, he objected in the strongest possible way to any interruption by Mr. Schwabe or Mr. Branson, who had been left to look after the interests of the Post Office. But his effort was in every way a masterful one: and, although to Post Office ears he seemed at times to put an entirely wrong construction on both facts and figures, his arguments were generally to the point, and in some respects the Post Office case was left in rags after his destructive criticism. In the first instance he somewhat changed his attitude as regards "tramway terms." He now claimed that valuation on tramway terms was artificial in character, that the company offered as evidence of what it would cost to reconstruct their system proofs of what it had cost them, and that the Post Office merely offered estimates based upon the probable doings of a supposititious contractor, and supported by the evidence of contractors who hoped for future benefits from the Post Office. He claimed repeatedly that the Post Office evidence was merely an attempt to whittle away the honest claims of the Company by innuendo, and towards the end, it seemed as though the Court and everyone present had mental visions of the "Mikado" whenever mention was made of the punishment of "whittling away by innuendo." Sir Alfred attacked the Solicitor-General's checks most vigorously and they certainly suffered severely. He also criticised the North Wales figures put forward by the Post Office, and contrasted the total amount of expenditure in North Wales (£30,000) with the figures for the composite year put forward by the Company as a basis of calculation (£1,000,000). He said that the Post Office ought to have put forward figures based on the cost of the Post Office works, and glozing over the differences in construction, type, situation and general conditions, asserted with some heat that they had been afraid to do so. In summing up the various details of the Company's claim, he agreed that the item of discounts in the calculation as to the cost of raising capital should be omitted, but he maintained that every halfpenny of the remainder of the Company's claim ought to be met. He defended the item of sub-contractors' charges on the ground that they had been taken out of the Company's figures when an agreement was arrived at as regards fundamental cost and must be replaced somewhere; and he claimed that life meant the time for which the plant would remain useful if the working conditions remained unaltered, and consequently, as no allow-



Digitized by Google

ance was made for future profits, no consideration ought to be given to the requirements of expanding business, etc., or to improved methods of working. He asked the Court to allow the cost of raising capital on the ground that no system could be constructed without the expense of financing it, and the cost of obtaining subscribers' agreements on the grounds that the system could not be constructed without detailed information as regards the situation of the subscribers' apparatus, and that such cost was analogous with the cost of obtaining statutory powers which had always been allowed in previous tramway arbitrations. Sir Alfred was at his best when singing the praises of the sinking-fund method of depreciation, but he did not seem to remove the bad impression created by the admissions of his own witnesses that they had never known it used in the case of a sale.

At the conclusion of Sir Alfred's speech, both parties handed in revised summaries dealing with the headings Nos. I, II, III, IV and V, and the Solicitor-General, who had no right to address the Court again, very cleverly directed the attention of the Court to the fact that the percentages in the Company's summary had been altered in order not to alter the totals.

The statement on p. 241 shows the comparative figures for these headings, and in the last columns the award of the Court for each of the various items. The award was given on January 13th, 1913.

The total amount of £13,059,827 was reduced to £10,062,607 on account of depreciation, and to this amount was added the agreed amount as regards the other headings, viz. £2,055,468, and the sums awarded by the Court as the cost of raising capital £247,189, and the cost of obtaining subscribers' agreements £150,000, making a total of £12,515,264. Sir James Woodhouse considered that the cost of raising capital ought not to be allowed, and disagreed with the majority of the Court in this respect. Costs were awarded against the Post Office.

The Post Office appealed against the award as regards the cost of raising capital and the cost of obtaining subscribers' agreements; and the Company on a counter-appeal raised various points which, in effect, were tantamount to asking the Court of Appeal to re-open the whole case. The appeal came before the Court of Appeal, composed of the Master of the Rolls (Sir H. H. Cozens-Hardy), Lord Justice Buckley and Lord Justice Kennedy, on April 15th, when Mr. Danckwerts raised an ingenious point of jurisdiction whether in this case, which was an arbitration under a special Act of Parliament, there was any right of appeal from the Judgment of the Railway and Canal Commission. The Appeal Court decided that a right of appeal did exist; and the House of Lords, to whom the Company appealed on this point, upheld that view.

When the case was again brought before the Court of Appeal,



Digitized by Google

## HEADINGS I, II, III, AND IV.

| Item. | Description. | National Telephone Company. | | G.P.O. | | Railway and Canal Commission. | |
|---|---|---|---|---|---|---|---|
| | | Amount. | Percentage on item E. | Amount. | Percentage on item E. | Amount. | Percentage on item E. |
| | | £ | | £ | | £ | |
| A. | Material at suppliers, manufacturers' profits, and wastage | 6,963,353 | — | 6,963,353 | — | 6,963,353 | — |
| B. | Freight, etc. | 375,375 | — | 375,375 | — | 375,375 | — |
| C. | Wages and expenses up to and including gang foreman, tools and sundries (including the item (F) in P.M.G. 10) | 2,857,752 | — | 2,857,752 | — | 2,857,752 | — |
| D. | Casualty insurance | 42,865 | — | 42,865 | — | 42,865 | — |
| E. | AGREED FUNDAMENTAL COSTS | 10,239,345 | 100 | 10,239,345 | 100 | 10,239,345 | 100 |
| F. | Sub-contractor's supervision | 162,279 | 1·58 | Included in item J | — | — | — |
| G. | Sub-contractor's profit | 57,136 | 0·56 | Included in item K | — | — | — |
| H. | Ordering and storing material | 468,298 | 4·57 | Included in items C, J, O | — | 267,759 | 2·61 |
| I. | Contingencies | 296,034 | 2·89 | Included in items A, C, D | — | — | — |
| J. | Contractor's (or local) supervision and administration | 1,992,144 | 19·46 | 600,128 | 5·86 | 660,732<br>267,759 | 6·41<br>2·61 |
| K. | Contractor's profit | 1,377,027 | 13·45 | 600,650* | 5·87 | 300,000 | 2·92 |
| L. | TOTAL CONTRACTOR'S CHARGES | 14,592,263 | 142·51 | 11,440,133 | 111·73 | 11,735,595 | 114·61 |
| M. | Obtaining wayleaves | 168,179 | 1·64 | 42,635 | 0·42 | 100,000 | ·97 |
| N. | Wayleave payments, rent of premises, maintenance and insurance of plant until revenue-earning | 264,821 | 2·59 | *Nil* | — | 200,000 | 1·95 |
| O. | Consulting engineer's fees (or head office supervision and administration) | 1,449,522 | 14·16 | 574,138 | 5·61 | 560,806 | 5·47 |
| P. | Interest during construction | 769,985 | 7·52 | Included in "Total Contractor's Charges" so far as relates to contractor's working capital | — | 463,426 | 4·52 |
| Q. | Cost of raising capital | 765,657 | 7·48 | *Nil* | — | See nett addition | — |
| R. | TOTAL COST OF CONSTRUCTION | £18,010,427 | 175·90 | £12,056,906 | 117·76 | £13,059,827 | 127·54 |

* Manufacturer's profit on material is contained in item A, and amounts to £439,352. If this is added to item K, the total contractor's profit allowed by the Post Office is £1,040,012, or 10·16 per cent. on the agreed fundamental costs.

Digitized by Google

## THE NATIONAL TELEPHONE COMPANY, LIMITED.—VALUATION OF PLANT.—TABLE I.

PARTICULARS OF CLAIM.—*Heading No.* 1 (1) (*a*). UNDERGROUND PLANT.—*Conduits· Unit Cost.—One Mile* 3*-inch Cast Iron Pipe* (*including Wood Plugs, Draw Wire, and Split Pipes*).

*Item No.* 24, *Page* (3), *Conduits* (*F.G.* 2).

| A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| Item No. | Material. | Quantity. | Rate. | Cost. | Weight. Tons. | Freight. From Suppliers. | Freight. Local. | Cartage. | Wastage. | Total. |
| | | | £ s. d. | £ s. d. | | £ | £ | £ | £ | £ |
| 1 | Pipes, 9-ft. length | 567·69 | 0 4 7·23 | 130 12 9·52 | 26·5415 | 17·3581 | ·9069 | 1·0550 | 4·2669 | |
| | Pipes bell-mouths, | 48·8 | 0 3 3·71 | 8 1 5·85 | | | | | | |
| | Wood plugs | 7·726 | 0 0 3·14 | 0 2 0·26 | ·0254 | ·0511 | ·0015 | ·0023 | ·0187 | |
| | Draw wire | Tons ·0697 | 9 6 3·05 | 0 12 11·78 | ·1744 | ·1987 | ·0106 | ·0158 | ·0188 | |
| | Split pipes indicator | 1·94 | 0 2 10·99 | 0 5 7·88 | ·0138 | ·0166 | ·0008 | ·0007 | ·0003 | |
| | | | | 139 14 11·29 | 26·7551 | 17·6245 | ·9198 | 1·0738 | 4·3047 | 163·6698 |
| | | | | £139·7470 | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 5 | WAGES, EXPENSES, TOOLS, SURFACE RE-INSTATEMENT— | | | | |
| | Laying ducts | | | £162·7713 | |
| | Pilot holes | | | 3·2375 | |
| | Other extras | | | 21·4414 | |
| | Tramway and railway crossings | | | 4·8202 | |
| | Company's supervision | | | 5·7681 | |
| | Cost of reinstating | | | 166·3629 | |
| | Extra for work in London | 1·2264 per cent. of | £528·0712 | 6·4763 | |
| | Casualty insurance | ·96 ,, ,, | 534·5475 | 5·1317 | —376·0094 |
| 6 | Ordering and storing material | 5·265 ,, ,, | 534·5475 | | 28·1439 |
| 7 | Maintenance and insurance of plant until it becomes revenue earning | ·007 ,, ,, | 534·5475 | | ·0374 |
| | SUPERVISION, ENGINEERING AND ADMINISTRATION— | | | | |
| 8 | Local engineering supervision | 11·311 ,, ,, | 534·5475 | 60·4627 | |
| | Local administrative ,, | 9·643 ,, ,, | 534·5475 | 51·5464 | —112·0091 |
| | | | | | 679·8696 |
| 9 | Head office engineering, 5 per cent.. | | | 33·9935 | |
| | Head office administration, 5·838 per cent. | | | 39·6908 | —73·6843 |
| | | | | | 753·5539 |
| 10 | CONTINGENCIES, 2 per cent. | | | | 15·0711 |
| | | | | | 768·6250 |
| 11 | INTEREST DURING CONSTRUCTION— | | | | |
| | (*a*) On cost of plant, 5 per cent for 1 year on | | 768·6250 | 38·4313 | |
| | (*b*) On working capital, 5 per cent. for 2 years on 1 per cent. of | | 768·6250 | ·7686 | —39·1999 |
| 12 | CONTRACTORS' PROFITS, 8·75 per cent. of | | 768·6250 | | 67·2547 |
| | | | | | 875·0796 |
| 13 | COST OF RAISING CAPITAL, 4·44 per cent. | | | | 38·8535 |
| | | | | | 913·9331 |
| 14 | Add for cost of split pipes, 17·35 pipes at £1·3700 (each as per unit cost) | | | | 23·7695 |
| 15 | | | | | £937·7026 |
| 16 | Unit cost used in Claim, £937·6991. | | | | |



Digitized by Google

on June 23rd, it was announced that the parties had come to an arrangement, and that the appeal and counter-appeal should be dismissed. The Court offered their congratulations to the parties on the final settlement of the matter, and, on July 1st, made the necessary order. Under the arrangement between counsel, the appeal and cross-appeal were withdrawn on condition that the purchase price of the plant and other property should be reduced by £45,000 and the Company should waive the payment of their costs, for which a claim of £122,000 had been made. The total sum payable to the Company was therefore reduced to £12,470,264, which is properly comparable with the original claim of the Company of £20,924,700 for plant, etc., and £122,000 for costs.

The tax-payers of this country are to be congratulated on the result of the arbitration, which was carried to such a successful conclusion by means of the almost superhuman efforts of the Law Officers, their assistants, and the Post Office Staff. The Post Office obtains the telephone system without making any payment in respect of goodwill or of the reserve fund which was invested in the business; and on the other hand, the Company obtains a sufficient price to enable the Liquidator to pay out the Shareholders at par, the Shareholders having received dividends of 5 per cent. or 6 per cent. for many years.

The only parties who really suffered by the terms of the award are those misguided individuals who, tempted by the generally accepted notion that in a business deal a Government department always comes out second best, speculated on the probabilities of the amount of the award being considerably in excess of the subscribed capital, and bought shares in recent months at as much as 50 per cent. above their face value. We need not waste our sympathy on them.

The following statistics may be of interest:

*Plant purchased.*—1,500,000 miles of wire: 1565 exchanges: 561,738 subscribers' and private wire stations.

*Number of days' proceedings.*—In Railway and Canal Court (Preliminary), 9; in Appeal Court (preliminary), 6; in Railway and Canal Court (1912–13), 74; in Appeal Court (1913), 4; House of Lords, 2; total, 95.

Sir John Simon's opening and closing speeches occupied sixteen days and covered 883 pages of the *verbatim* report of the proceedings. Sir Alfred Cripps spoke for fifteen days and his speeches covered 732 pages of the report. Mr. Gill was in the witness-box on thirteen days and Mr. Snell on fourteen days. The *verbatim* report and the papers handed in to the Court, when placed one on another, measure nearly 4 ft. in height.

Everybody who was present in the Courts during the hearing



Digitized by Google

# TABLE OF

## I. (1) UNDERGROUND

| I. | II. | | III. | | IV. | | V. | VI. | |
|---|---|---|---|---|---|---|---|---|---|
| Class of conduit. | Material based on prices as on December 31st, 1911. | | **Splits and bends** on agreed basis, including re-excavation, filling in, and extra width of reinstatement, and contractor's profit. | | **Freight.** | | **Contractor's profit** on material and freight (10 per cent. on Cols. II. and IV.). | Contract rates for unloading and carting out stores. **Excavation** to agreed average excess depth, trenching in rock, laying and filling-in, and contractor's profit | |
| | Index **C.M.** No. | Cost per mile. | Index **C.S.** No. | Cost per mile. | Index **C.F.** No. | Cost per mile. | Cost per mile. | Index **C.E.** No. | Cost per mile. |
| **CAST IRON PIPES.** | | £ | | £ | | £ | £ | | £ |
| 1 2-in. C.I. . | 1 | 77·000 | — | — | 2 | 6·757 | 8·376 | 8 | 250·337 |
| 1 3-in. C.I. . | 2 | 121·000 | 1 | 13·539 | 2 | 10·476 | 13·148 | 8 | 250·337 |
| 1 4-in. C.I. . | 3 | 220·000 | — | — | 2 | 15·505 | 23·550 | 8 | 250·337 |
| 1 6-in. C.I. . | 4 | 306·533 | — | — | 2 | 27·867 | 33·440 | 9 | 196·849 |
| 2 3-in. C.I. . | 2 | 242·000 | 1 | 21·725 | 2 | 20·952 | 26·295 | 10 | 407·508 |
| 2 4-in. C.I. . | 3 | 440·000 | — | — | 2 | 31·010 | 47·101 | 11 | 407·508 |
| 3 3-in. C.I. . | 2 | 363·000 | — | — | 2 | 31·428 | 39·443 | 12 | 502·125 |
| 4 3-in. C.I. . | 2 | 484·000 | — | — | 2 | 41·904 | 52·590 | 13 | 568·744 |
| 5 3-in. C.I. . | 2 | 605·000 | — | — | 2 | 52·380 | 65·738 | 14 | 485·467 |
| 6 3-in. C.I. . | 2 | 726·000 | — | — | 2 | 62·856 | 78·886 | 14 | 523·967 |
| 7 3-in. C.I. . | 2 | 847·000 | — | — | 2 | 73·332 | 92·033 | 15 | 605·051 |
| 8 3-in. C.I. . | 2 | 968·000 | — | — | 2 | 83·808 | 105·181 | 15 | 643·551 |
| 9 3-in. C.I. . | 2 | 1089·000 | — | — | 2 | 94·284 | 118·328 | 15 | 682·051 |
| 9 4-in. C.I. . | 3 | 1980·000 | — | — | 2 | 139·545 | 211·954 | 16 | 840·877 |
| 10 3-in. C.I. . | 2 | 1210·000 | — | — | 2 | 104·760 | 131·476 | 17 | 776·417 |
| 11 3-in. C.I. . | 2 | 1331·000 | — | — | 2 | 115·236 | 144·624 | 17 | 814·917 |
| 12 3-in. C.I. . | 2 | 1452·000 | — | — | 2 | 125·712 | 157·771 | 17 | 853·417 |
| 13 3-in. C.I. . | 2 | 1573·000 | — | — | 2 | 136·188 | 170·919 | 18 | 973·300 |
| **14 3-in. C.I.** . | 2 | 1694·000 | — | — | 2 | 146·664 | 184·066 | 18 | 1011·890 |
| **15 3-in. C.I.** . | 2 | 1815·000 | — | — | 2 | 157·140 | 197·214 | 18 | 1050·390 |
| **16 3-in. C.I.** . | 2 | 1936·000 | — | — | 2 | 167·616 | 210·362 | 18 | 1088·890 |
| **17 3-in. C.I.** . | 2 | 2057·000 | — | — | 2 | 178·092 | 223·509 | 19 | 1268·329 |
| **18 3-in. C.I.** . | 2 | 2178·000 | — | — | 2 | 188·568 | 236·657 | 19 | 1306·829 |
| **19 3-in. C.I.** . | 2 | 2299·000 | — | — | 2 | 199·044 | 249·804 | 19 | 1345·329 |
| **20 3-in. C.I.** . | 2 | 2420·000 | — | — | 2 | 209·520 | 262·952 | 19 | 1383·829 |
| **21 3-in. C.I.** . | 2 | 2541·000 | — | — | 2 | 219·996 | 276·100 | 20 | 1483·673 |
| **22 3-in. C.I.** . | 2 | 2662·000 | — | — | 2 | 230·472 | 289·247 | 20 | 1522·173 |
| **32 3-in. C.I.** . | 2 | 3872·000 | — | — | 2 | 335·232 | 420·723 | 21 | 2233·213 |
| **33 3-in. C.I.** . | 2 | 3993·000 | — | — | 2 | 345·708 | 433·871 | 21 | 2271·713 |

Key to Index references: C.M. = Conduits, materials. C.S. = Conduits, splits and bends. C.P. = Conduits, extras



Digitized by Google

## COST.—TABLE II.

### PLANT. (*a*) CONDUITS.

| VII. | | | VIII. | | IX. | X. | XI. | XII. | XIII. | XIV. |
|---|---|---|---|---|---|---|---|---|---|---|
| Contract rates for **reinstatement** of roadways and footways, including contractor's profit. | | | **Extras on contract rate to cover abandoned pilot holes, concrete, timber in trench, extra widths, shoring pipes, etc., and contractor's profit. Index C.P. 1.** | | **Petty materials and sundries (1 per cent. on Col. II). Index C.P. 2.** | **Total cost per mile.** | Total mileage of conduits as in agreed inventory of 68 centres. | **Total cost of construction as on 31st December, 1911.** | Equivalent miles of single duct. | Remarks. |
| Group. | Index **C.R.** No. | Cost per mile. | Percentage on Cols. VI.+VII. | Cost per mile. | Cost per mile. | | | | | |
| | | £ | | £ | £ | £ | | £ | | |
| D | | | 2 | 5·007 | 0·770 | 348·247 | 0·428 | 149·050 | 0·428 | |
| D | Included in cost under Col. VI | | 2 | 5·007 | 1·210 | 414·717 | 1062·218 | 440519·862 | 1062·218 | |
| D | | | 2 | 5·007 | 2·200 | 516·599 | 0·145 | 74·907 | 0·145 | |
| D | 4*a* | 191·044 | 2 | 7·758 | 3·065 | 766·556 | 0·359 | 275·194 | 0·359 | |
| E | Included in cost under Col. VI | | 3½ | 14·263 | 2·420 | 735·163 | 92·240 | 67811·435 | 184·480 | |
| E | | | 3½ | 14·263 | 4·400 | 944·282 | 0·001 | 0·944 | 0·002 | |
| E | | | 6 | 30·128 | 3·630 | 969·754 | 27·976 | 27129·838 | 83·928 | |
| E | | | 6 | 34·125 | 4·840 | 1186·203 | 8·304 | 9850·230 | 33·216 | |
| F | 6 | 486·069 | 15 | 145·730 | 6·050 | 1846·434 | 1·395 | 2575·775 | 6·975 | |
| F | 6 | 486·069 | 15 | 151·505 | 7·260 | 2036·543 | 3·935 | 8013·796 | 23·610 | |
| F | 6 | 486·069 | 15 | 163·668 | 8·470 | 2275·623 | 1·042 | 2371·199 | 7·294 | |
| F | 6 | 486·069 | 15 | 169·443 | 9·680 | 2465·732 | 1·338 | 3299·149 | 10·704 | |
| F | 6 | 486·069 | 15 | 175·218 | 10·890 | 2655·840 | 0·871 | 2313·237 | 7·839 | |
| F | 6 | 486·069 | 15 | 199·042 | 19·800 | 3877·287 | 0·001 | 3·877 | 0·009 | |
| F | 6*a* | 545·964 | 15 | 198·357 | 12·100 | 2979·074 | 0·285 | 849·036 | 2·850 | |
| F | 6*a* | 545·964 | 15 | 204·132 | 13·310 | 3169·183 | 0·208 | 659·190 | 2·288 | |
| F | 6*a* | 545·964 | 15 | 209·907 | 14·520 | 3359·291 | 0·332 | 1115·285 | 3·984 | |
| F | 6*a* | 545·964 | 15 | 227·903 | 15·730 | 3643·094 | 0·418 | 1522·813 | 5·434 | |
| F | 6*a* | 545·964 | 15 | 233·678 | 16·940 | 3833·202 | 0·031 | 118·829 | 0·434 | |
| F | 6*a* | 545·964 | 15 | 239·453 | 18·150 | 4023·311 | 0·045 | 181·049 | 0·675 | |
| F | 6*a* | 545·964 | 15 | 245·228 | 19·360 | 4213·420 | 0·015 | 63·201 | 0·240 | |
| G | 7 | 582·647 | 15 | 277·646 | 20·570 | 4607·793 | 0·072 | 331·761 | 1·224 | |
| G | 7 | 582·647 | 15 | 283·421 | 21·780 | 4797·902 | 0·059 | 283·076 | 1·062 | |
| G | 7 | 582·647 | 15 | 289·196 | 22·990 | 4988·010 | 0·034 | 169·592 | 0·646 | |
| G | 7 | 582·647 | 15 | 294·971 | 24·200 | 5178·119 | 0·163 | 844·033 | 3·260 | |
| G | 7 | 582·647 | 15 | 309·948 | 25·410 | 5438·774 | 0·189 | 1027·928 | 3·969 | |
| G | 7 | 582·647 | 15 | 315·723 | 26·620 | 5628·882 | 0·151 | 849·961 | 3·322 | |
| G | 7 | 582·647 | 15 | 422·379 | 38·720 | 7904·914 | 0·032 | 252 957 | 1·024 | |
| G | 7 | 582·647 | 15 | 428·154 | 39·930 | 8095·023 | 0·055 | 445·226 | 1·815 | |
| | | | | | | Totals . . | 1202·342 | 573102·430 | 1453·434 | |

**C.F** = Conduits, freight. C.E. — Conduits, excavation. C.R. = Conduits, reinstatement. **and petty materials.**



Digitized by Google

must have been impressed with the careful thought and strict attention to the minutiæ of details which both parties have given in the preparation of their cases. The labours of our friends the enemy, especially of Mr. Gill and Mr. Cook, must have been enormous; and there was no mistaking the obvious enthusiasm of Mr. Slingo and all his assistants, especially Mr. De Lattre and Mr. Martin, in their efforts to obtain for the State the telephone system at its "fair market value." And last but not least, Sir Robert Hunter, who conducted the Post Office case, added further lustre to his long and brilliant career in the service of the State.

In the overwhelming bulk of figures, weighted and equated averages, unit costs, splits and bends, and other weird and wonderful things, the lighter side of the human character was not often uppermost during the conduct of the case; but there were one or two sparks of humour among the dry-as-dust material. For instance, Mr. Danckwerts, never at a loss for an example, mentioned the youthful Solicitor-General as an instance of the increase of revenue-earning capacity with age. The Post Office engineers, who early found that the seats in the jury-box had cushions and stayed there, received offerings in the shape of halfpence from the ladies' gallery. Mr. Swinburne, when saying that if he were a moneylender he would prefer compound interest, was informed by the Bench that they did not contemplate coming to him for a loan. Sir Alfred Cripps referred to Mr. Danckwerts as a jockey, and one wondered whether it would not need an "iron horse" to complete the analogy. The Solicitor-General, at the instance of Mr. Danckwerts, inquired of Mr. Snell whether stray currents were found in the sheaths of other than lead-covered cable; and, later on, he expressed the hope that Mr. Snell (and presumably his evidence) would not suffer too much from electrolytic action during the process of cross-examination. Mr. Slingo supported the teetotal movement by declaring that water, with nothing in it, would not cause electrolysis. But we had no "bull" to compare with the description of a multiple, which was given during the preliminary proceedings, as the things that stick out on the front of the switchboard.

## TESTING INSULATION RESISTANCE WITH THE DETECTOR NO. 2.

The scope of the detector No. 2 is not exhausted when used for the purposes already indicated in past issues of this JOURNAL. It can be used to ascertain the insulation resistance of lines in the same manner as the voltmeter test set equipped at all large exchanges.



Digitized by Google

Naturally the detector has not such a large range nor the sensitiveness of the proper voltmeter set, but it serves very well in ascertaining roughly the state of lines, and is very useful for this purpose at small exchanges where there is no standard testing equipment.

The detector has a scale of fifty divisions, and the needle gives full deflection when fifty volts are applied to the instrument with no external resistance in circuit. Since the resistance of the instrument is 5000 ohms. the current is 10 m.a., and each division represents $\frac{1}{5}$ m.a. From this the formula used—

$$\text{Insulation res.} = \frac{50 - \text{deflection}}{\text{deflection}} \times 5000,$$

is easily shown to be true.

With 5000 ω resistance in the external circuit the potential drop across the voltmeter terminals is obviously halved. The current is—

$$\frac{50{,}000}{10{,}000} \text{ mv.} = 5 \text{ m.a.}$$

$$= 25 \text{ divisions, and,}$$

$$5000 \text{ is equal to } \frac{50 - 25}{25} \times 5000$$

With 245,000ω external resistance the current is $\frac{50{,}000}{250{,}000} = \frac{1}{5}$ ma.

$$= 1 \text{ divn.}$$

$$\text{And } 245{,}000 \text{ is equal to } \frac{50 - 1}{1} \times 5000.$$

This is the highest insulation resistance that can be ascertained with the detector, but although this would be of no use in the larger towns where the plant is all underground, it is quite sufficient for small provincial towns where the lines are mostly open.

The following table gives the approximate external resistances corresponding with the deflections obtained on the detector, when a 50-volt battery is used with the 5000ω coils of the instrument:

| Deflection. | Resistance. | Deflection. | Resistance. |
|---|---|---|---|
| 1 | 245,000 | 13 | 14,200 |
| 2 | 120,000 | 14 | 12,800 |
| 3 | 78,500 | 15 | 11,700 |
| 4 | 57,500 | 16 | 10,600 |
| 5 | 45,000 | 17 | 9,750 |
| 6 | 36,700 | 18 | 8,870 |
| 7 | 30,700 | 19 | 8,150 |
| 8 | 26,300 | 20 | 7,500 |
| 9 | 22,900 | 21 | 6,920 |
| 10 | 20,000 | 22 | 6,280 |
| 11 | 17,700 | 23 | 5,860 |
| 12 | 15,800 | 24 | 5,420 |



Digitized by Google

| Deflection. | Resistance. | Deflection. | Resistance. |
|---|---|---|---|
| 25 | 5,000 | 38 | 1,580 |
| 26 | 4,620 | 39 | 1,410 |
| 27 | 4,250 | 40 | 1,250 |
| 28 | 3,930 | 41 | 1,095 |
| 29 | 3,630 | 42 | 955 |
| 30 | 3,330 | 43 | 815 |
| 31 | 3,060 | 44 | 672 |
| 32 | 2,820 | 45 | 556 |
| 33 | 2,580 | 46 | 435 |
| 34 | 2,350 | 47 | 320 |
| 35 | 2,140 | 48 | 208 |
| 36 | 1,940 | 49 | 102 |
| 37 | 1,750 | 50 | — |

Of course if a resistance of 5000" is inserted in series with the detector and a 100-volt battery is used, the external resistance measured will be double that given in the above table.

W. A.

---

## London District: Progress of New Equipments.

New Victoria: 8100 lines. Expected to utilise part of equipment early in October.

Museum: 10,000 lines. Commenced August 6th. Work proceeding rapidly.

Charterhouse: 10,000 lines. Office of Works engaged on building plans.

Kensington: Extension to 8400 lines. Approaching completion.

Hop Extension: "A" positions increased by 31; "B" positions converted to Keyless working. Practically completed.

Regent: Extension to 8080 lines. Practically completed. 4000 lines and 6500 stations connected in less than a year.

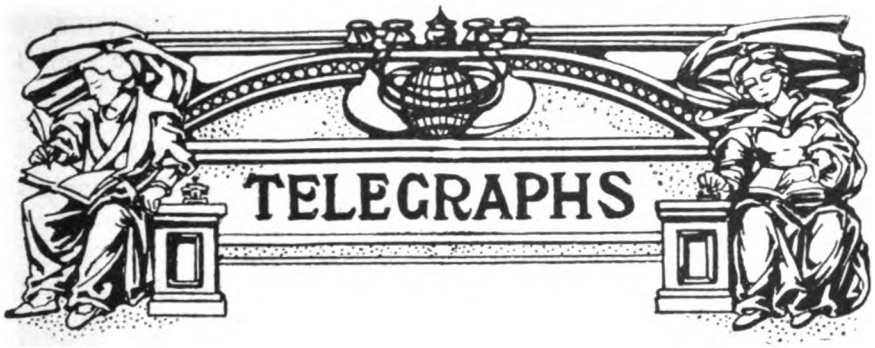
North: Extension by 1000 lines. Building being modified.

Trunk Exchange: Fifty Toll Sections to be installed by local staff. Fire Alarm system being introduced throughout the building.

Transfers.—The work of re-arranging the line plant has, during the last two years, absorbed a large amount of the time and energy of the District Staff. Another considerable instalment was completed on July 1st, when 3983 exchange lines were transferred to their appropriate exchanges. No hitch occurred, although the preliminary work had been of a complicated character, and next day Mr. Moir communicated to all concerned his appreciation of the satisfactory manner in which the work had been carried out. Subsequently a note commending the good work of the District was received from Headquarters, and, naturally, was much appreciated.



Digitized by Google




# THE CREED TELEGRAPH SYSTEM.

By E. Lack, A.M.I.E.E.

The General Post Office has had in use for some time, notably on the London-Edinburgh underground circuit, the Creed system for receiving and the subsequent printing in Roman characters of the ordinary Morse signals which have been sent by the Wheatstone transmitter.

In the usual method of Wheatstone working the operations which cause the greatest loss of time are, first, the preparation of the punched slips at the transmitting offices; secondly, the translation of the received signals at the intermediate stations; thirdly, the re-perforating for re-transmission; and lastly, at the terminal office, the writing up or printing of the received signals.

The first part of the problem, the simplification of the preparation of the punched slips, may be solved readily enough by means of a keyboard perforator such as the Gell, Pollak, or Kotyra.

The remaining causes of time loss are very greatly reduced by means of the Creed receiving perforator and the Creed printer.

## The Receiving Perforator.

The receiving perforator is designed to facilitate re-transmission and to save manual labour in the reception of telegrams.

For instance, a station "B" may have to transmit telegrams received from a station "A" to stations beyond.

Ordinarily in Wheatstone working the messages from "A," which are to be forwarded by "B," are received by the latter in the usual Morse signals. In order that they may be forwarded an operator at "B" has to prepare a new Wheatstone slip similar to that which was prepared at "A" in the first instance.

The object of the Creed receiving perforator at "B" is to avoid



Digitized by Google

the necessity of preparing a fresh Wheatstone slip by hand, and to perform the same operation automatically by means of the signals received on the line relay.

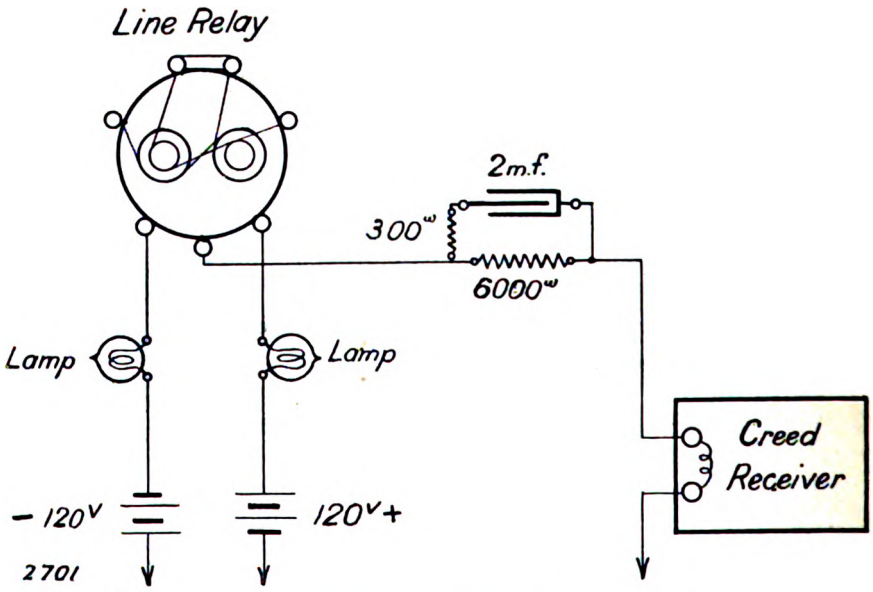
The mechanism for accomplishing this consists of—

(1) A relay.

(2) A perforator; this latter in its turn comprises three principal parts:

(*a*) Punches and a system for actuating them.

(*b*) A mechanism for carrying the slip forward at a speed uniform with that of the transmitter at the sending station.




1.—Creed Receiver. Electrical Connections.

(*c*) A method of holding the slip firm whilst it is being perforated, and then releasing it as soon as the perforation has been accomplished.

The two operations (*a*) and (*c*) are performed by pneumatic agencies, whilst the operation (*b*) is fulfilled by a friction arrangement which will be more fully explained later.

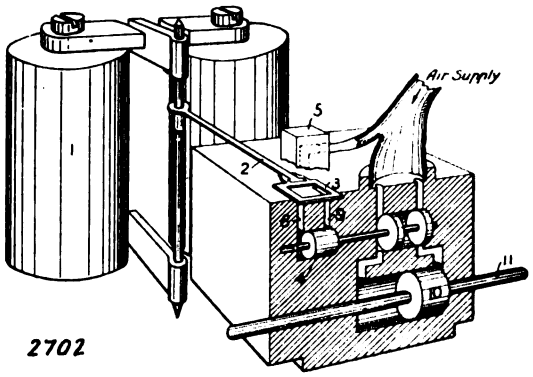
The line relay is actuated by currents in the usual way. The local connections are shown in 1.

Within the receiver is another relay similar in construction to the Post Office standard relay 1 (2), with the exception that *in lieu* of the usual tongue the spindle of the armature carries a light arm *2* (2), at the end of which is an arrangement for opening and closing a small air valve *3* (2), which controls the supply of air *viâ* the block

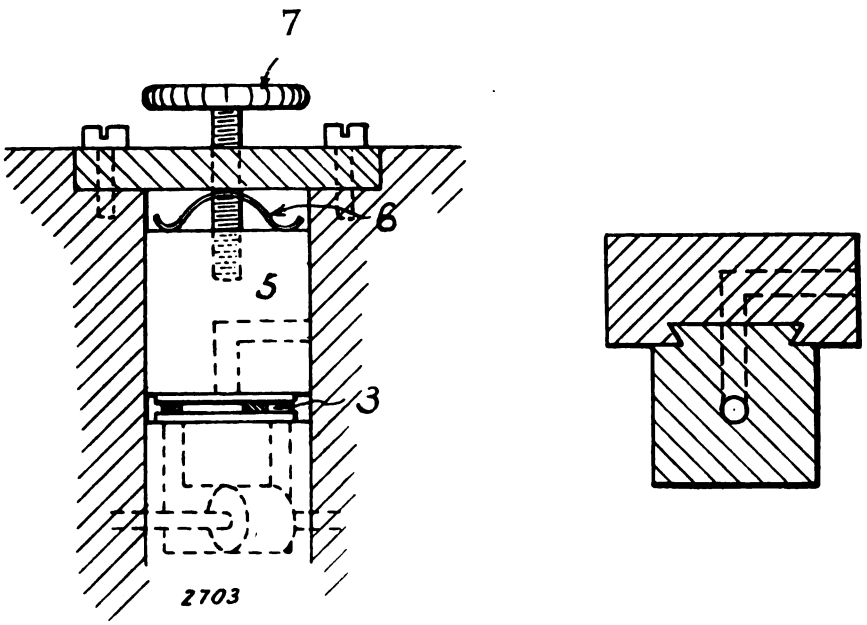


Digitized by Google

*5* (2) and the channels *8* or *9* to a small piston *4* (2). The pressure of the block *5* is regulated by means of the spring *6* (3) and the adjustable screw *7* (3). The small piston thus responds to the move-




2.—Sketch of Relay.




3.—Details of Air Valve.

ments of the relay in accordance with the currents received from the line.

On an extension of the small piston-rod is an arrangement for controlling the air supply to a larger piston, which, by means of a rod passing through it acts in turn on the adjacent arms of the

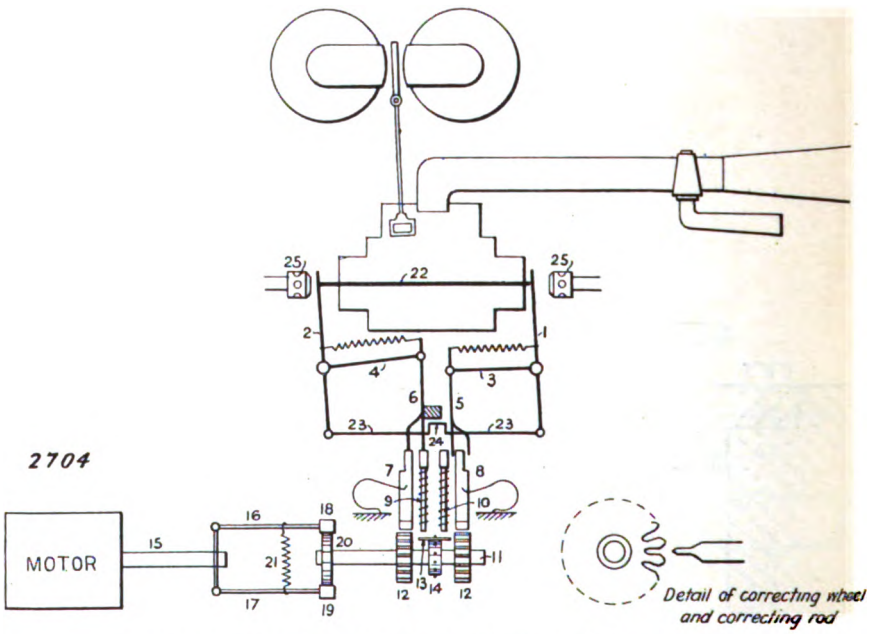


Digitized by Google

system of bell-crank levers *1* and *2* (4). The movement of the piston-rod and the levers *1* and *2* is regulated by means of the adjustable buffers *25* (4). Attached to the arms *3* and *4* (4) are two bifurcated hard-steel strikers *5* and *6* (4), the free ends of which force forward the correcting rods *7* and *8* and the punches *9* and *10* (4).

The correcting rods and punches are mounted and guided in a separate block with the die-plates of the perforator and the feed-wheel spindle *11* (4). (7) and (8) show the old and the new form of punch blocks.

The correcting rods *7* and *8* (4) have flattened extremities at one




4.—Creed Receiver. Sketch of Mechanical Arrangement.

end, *1* (5 and 6), which when thrust forward enter the slots of the correcting wheels *12* (4). Retracting springs are provided to restore the rods to their normal positions against stops in the punch blocks. (5) and (6) show the earlier and later methods of doing this. The punches are equipped with springs in like manner.

The Wheatstone paper slip *13* (4) is centre-holed in order that it may be fed forward.

It is placed in the paper guide, and by means of the centre holes engages with the star-wheel *14* (4), and is led upwards between the die plates and past the punches. The star wheel and the correcting wheels are fixed to the spindle *11* (4).

When the point of either correcting rod *7* or *8* (4) is thrust



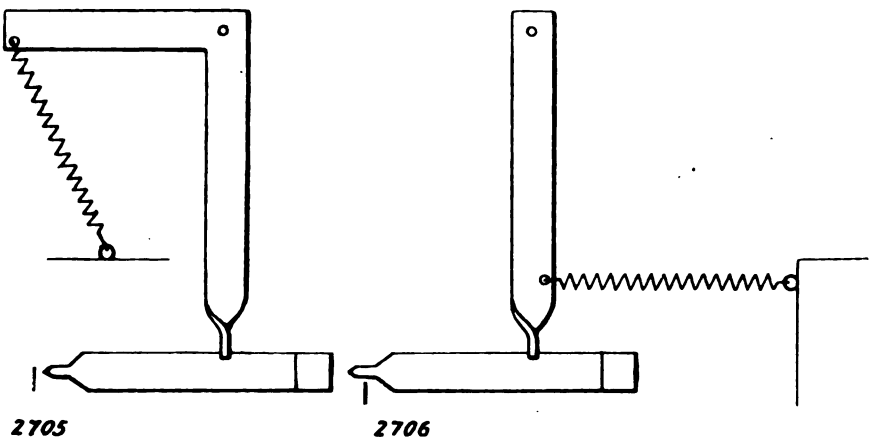
Digitized by Google

forward by the striker *5* or *6* (4), it enters the space between the teeth of the correcting wheel, and thus adjusts the position of the wheel and holds it and the paper firmly in such a manner that the corresponding punch *9* or *10* (4) will perforate the paper exactly opposite the centre or feed holes.

The spindle *11* (4) is rotated by an electric motor whose spindle *15* (4) is connected to it by means of jointed arms *16* and *17* (4), which have friction blocks *18* and *19* (4) pressing on the disc *20* (4). The friction is regulated by means of spring *21* (4), which can be moved to the right or left along the rods *16* and *17* (4).

The action of the apparatus is as follows:

When a current is received in the relay *1* (2) its armature *2* (2) moves to the right or left, dependent on the direction of the current through the relay coils.



*2705* *2706*

5 AND 6.—CORRECTING RODS, OLD AND NEW FORM.

If a " marking " current be received the light arm *2* (2) moves to the left. This opens the air-channel *8* (2), and the pressure of the air forces the piston *4* (2) to the right; this (as shown diagrammatically in 2) is connected with the main valve, which is opened in like manner, and the main piston *10* (2) is driven to the right also.

The actual connection between the small piston and main valve is by means of a cranked lever, which is clearly shown in the photograph (9).

The further action will now be seen by reference to 2 and 4.

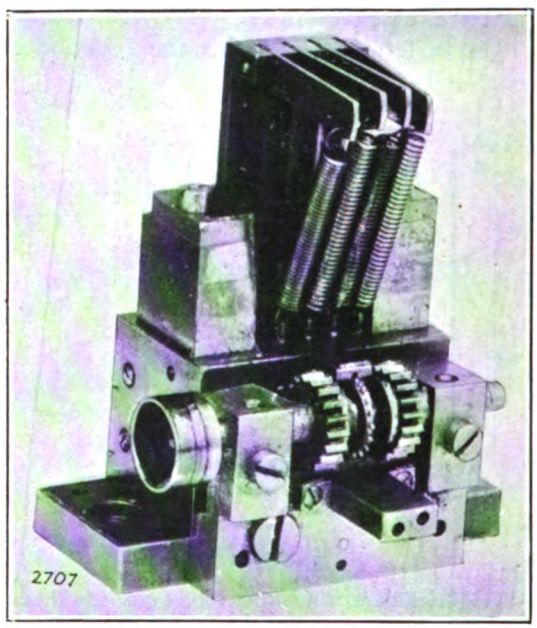
The motion of the main piston *11* (2) and *22* (4) is transmitted by means of the bell-crank *1* (4) and the link *23* (4) to the bell-crank *2* (4), which in turn causes the left-hand striker *6* (4) to force the sharp point of the correcting rod *7* (4) between the teeth of the correcting wheel *12* (4), thus adjusting the feed-wheel *14* (4) if



Digitized by Google

necessary, and pressing the punch *9* (4) through the paper slip *13* (4). The tappet piece *24* (4) on the link *23* (4) now comes in contact with the striker *6* (4), and pushing it aside from the correcting rod and punch allows them to withdraw from the correcting wheel and paper respectively through the action of the retracting springs and assume the normal position.

When the line-current is reversed the armature *2* (2) of the relay *1* (2) is moved in the opposite direction, the piston rods are reversed in their action, and another operation similar to that just described causes the correcting rod *8* and punch *10* (4) to be actuated.




7.—Creed Receiver. Punch Block, Old Form.

As the operation of forcing the correcting rods and punches forward occupies only about $\frac{1}{300}$th of a second, the time during which the movement of the feed-wheel is arrested is practically negligible, and the difference between the dots and dashes on the slip depends therefore on the time-interval between the successive spacing and marking contacts, during which time the tape is allowed to travel forward. In order to allow for the interval of time occupied by the reversal of the currents required for signalling a "dot," during which period the slip has travelled forward a little, the right-hand punch and correcting wheel are given a lead, so that, although the spacing punch comes into action a short time



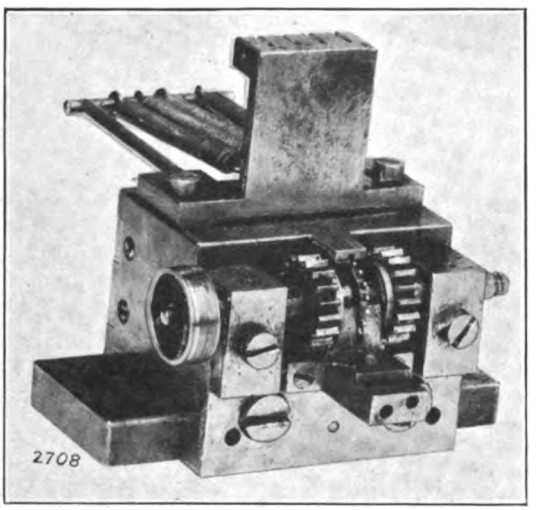
Digitized by Google

after the marking punch, the spacing perforation is made immediately opposite the same centre hole as the marking perforation.

**9** shows a plan of the receiving perforator, and **10** gives a front view of it, while **11** gives a closer view of the paper-driving mechanism.

The air supply is obtained by means of a small pump placed in the engine room, and is delivered at a pressure of 30 to 35 lbs. per square inch. A container is placed near the apparatus so as to avoid fluctuations of pressure when a variation in the number of instruments at work takes place.

The maximum speed of working which has been obtained




**8.**—Creed Receiver. Punch Block, New Form.

experimentally by the Department is 215 words per minute, but a speed of 150 words per minute is generally regarded as the maximum for reliable working.

## The Creed Printer.

The printer translates the signals on the received perforated slip and prints them in Roman characters on a paper tape. The tape is afterwards gummed on to an ordinary telegram form.

The action of the printer will be understood by means of the skeleton diagram shown in **12**.

The perforated slip, which is identical with ordinary Wheatstone slip, is shown passing through the printer on the right hand of the figure.

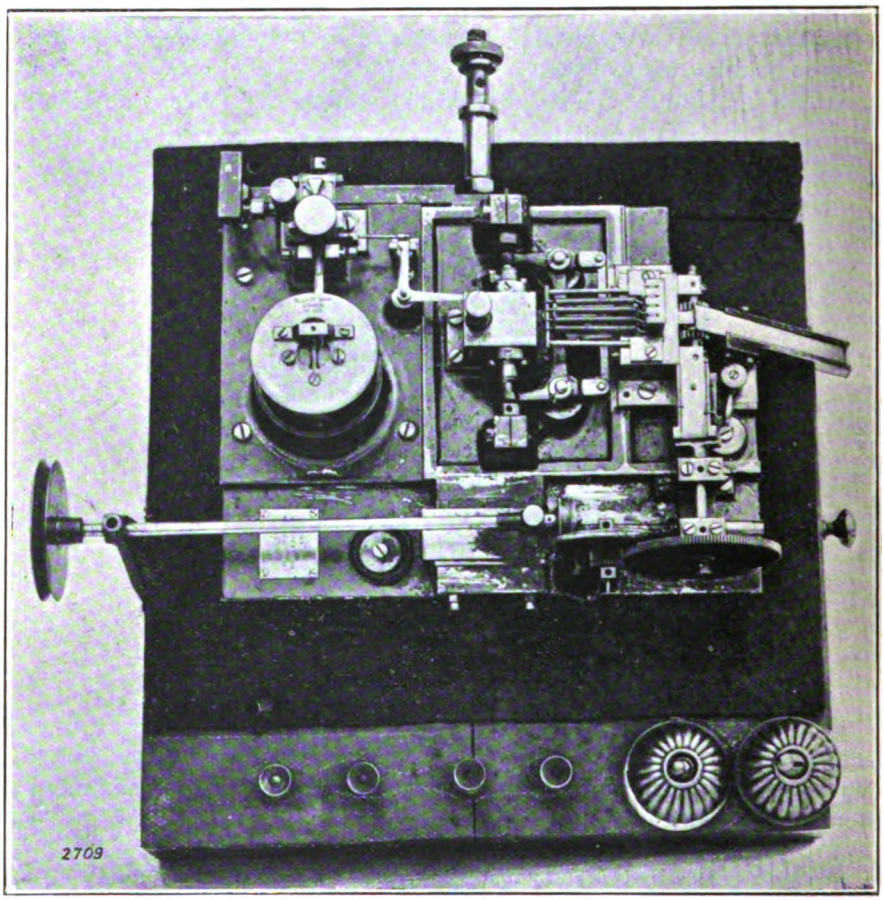
The roll of Morse paper which receives the printing is placed on



Digitized by Google

a wheel similar to that used in the Wheatstone receiver, and, guided by a roller, is then drawn forward between the connecting rods of the type bars by means of two rollers (between which it passes) which are driven by the mechanism. On its journey the slip passes over a printing platen and under a typewriter ribbon.

The perforated paper is fed upwards by means of a star wheel




9.—Creed Receiver. Plan.

fitted on a spindle carrying a toothed wheel, which is rotated as desired by the paper-lifting rack. The rack's movement is obtained by means of a cam on the main shaft of the printer, which is belt-driven from an electric motor.

The slip is drawn forward, letter by letter, in front of ten pairs of selecting needles. One pair only is shown in the figure, which, by means of small springs, are pressed against the paper and made

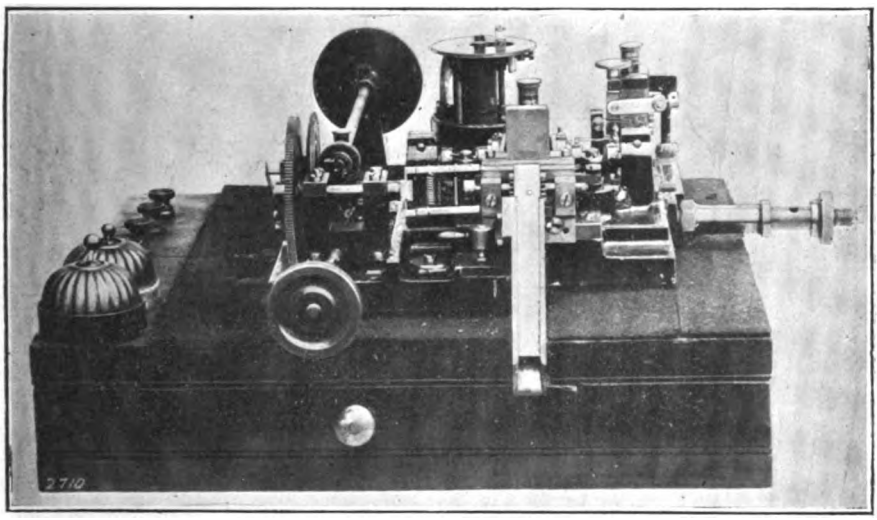


Digitized by Google

to enter the perforations that may happen to be immediately in front of them.

One of each pair of needles is connected to the hinged extension of a thin perforated plate or stopper sliding in the path of the air valves. Each of the ten slide plates can take two positions, and they thus provide a number of different combinations, every one of which opens one complete and particular passage through them. Air under pressure is admitted through the main valves below these plates, and through the passages thus opened to small cylinders placed immediately above them.

The type levers terminate in pistons which fit into the small



**10.**—Creed Receiver. Front Elevation.

cylinders, and as the plates are displaced the air acts on one or other of these pistons, and causes the corresponding type lever to print the letter or sign on the paper.

The movement of the slide valves or plates is determined by the paper-lifting rack. For this purpose the rack is given, independently of its up-and-down movement, a side motion, by means of which it pushes the slide valves which have been brought into its zone of action by the movement of the selecting needles.

The vertical motion of the paper-lifting rack is determined by the position of the first blank space in the slip; that is to say, it corresponds to the length of the letter which has been selected.

To provide for the variable vertical movement of the rack there is a group of ten space levers which are normally in its path, but

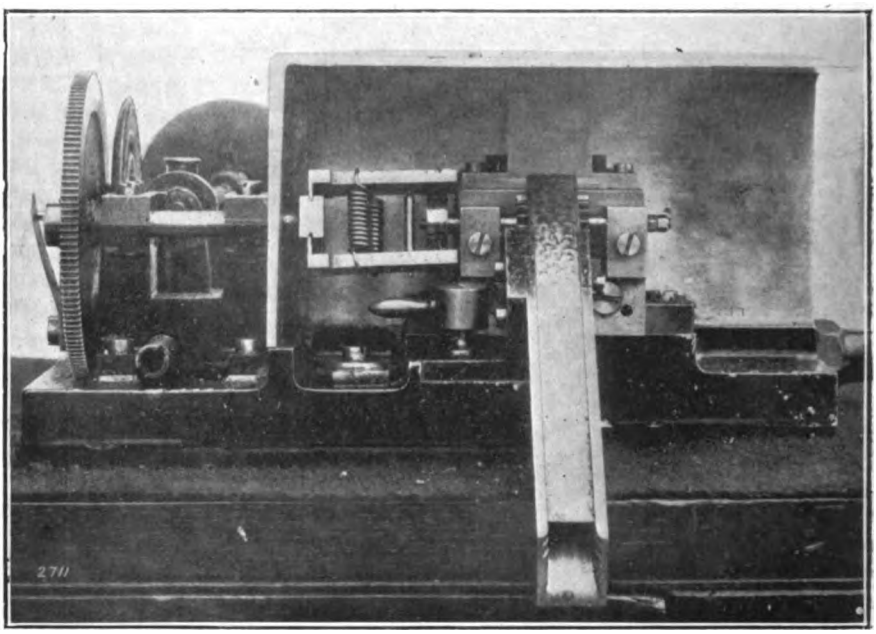


Digitized by Google

when the selecting needles pass through the holes in the slip they press these levers aside and thus allow it to descend.

The rack can therefore move downwards as far as the space signal between the letters, which it cannot pass, because the position of the corresponding space lever has not been altered.

In its downward movement the rack does not engage with the toothed wheel which governs the movement of the paper, but at the end of its vertical motion it is moved laterally by means of a cam on the main spindle, and thus presses against the selected slide valves, and then engages with the toothed wheel of the paper-moving



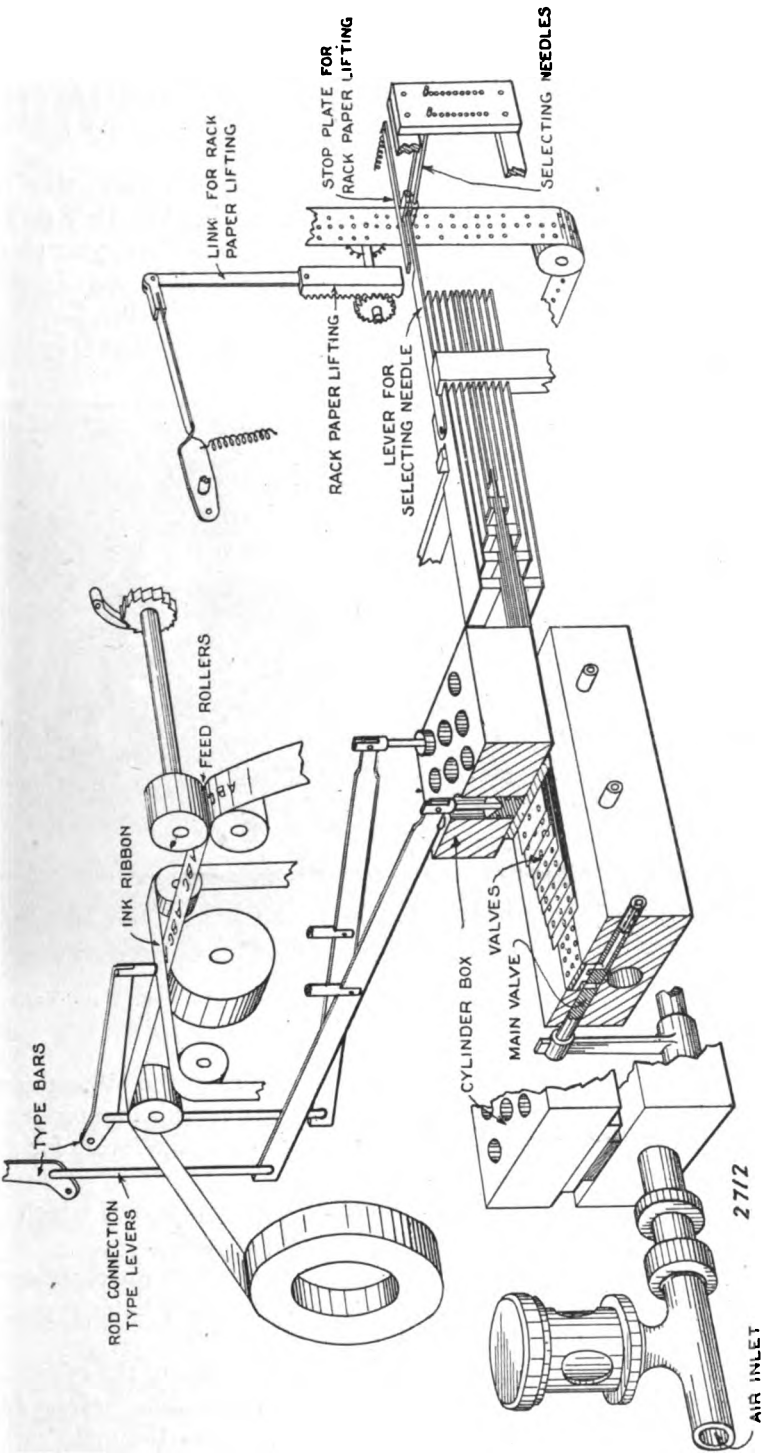
II.—Creed Receiver. Punch Block and Friction Drive.

mechanism. The rack then rises and the slip is drawn upward, and as the amplitude of the rack's rising motion is equal to that of its descent the paper is lifted exactly the length of the letter which has just been printed. The slip is now in position ready for the selection of the next letter. The stop plates are formed of thin plates of steel; they are each provided with a hinged extension, which can follow the movements of the selecting needles, and at the same time it and the plate are free to move in a direction at right angles to them; in addition the extension is provided with a shoulder against which the paper-lifting rack presses in its lateral movement.

The admission of the air into the distributor is controlled by four main valves, which are actuated by a cam on the main shaft only



Digitized by Google




12.—Creed Printer. Skeleton Diagram of Main Parts.

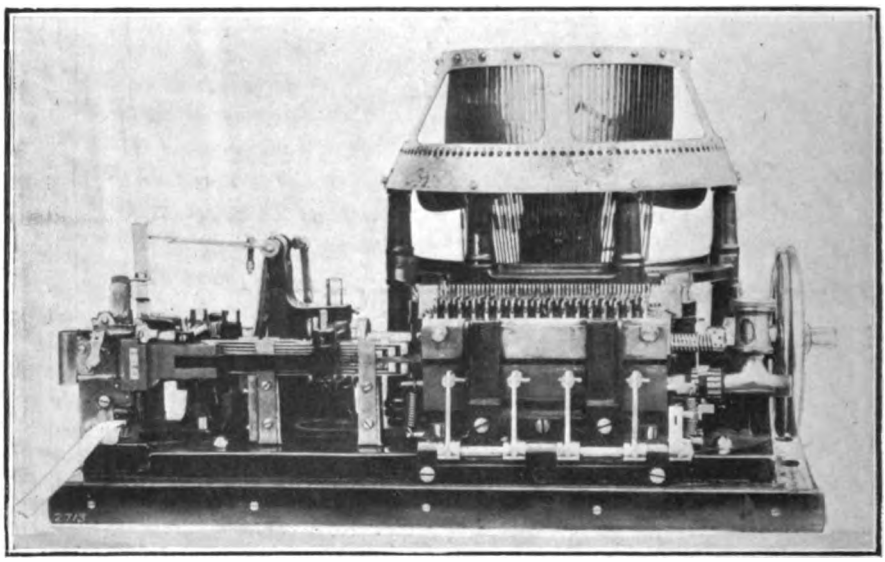


Digitized by Google

after the paper-lifting rack has pushed the selected stop plates into the working position. After the letter has been printed the four valves move into a second position, the air then escapes, and at the same time the stop plates are brought back to their normal position by means of a cam on the main shaft.

It may be remarked that the selecting needles may enter the holes of the following letter or letters in the slip, but they do not affect the printing of the proper signal, because the stopping plates are not actuated by the paper-lifting rack as it does not descend beyond the first space after the letter which is being printed.

As previously stated, there are twenty selecting needles (10 pairs),



13.—Creed Printer. Back Elevation, showing Cylinder Box, Main Valves, Stopping Plates, etc.

but only the ten acting on the lower row of holes in the Wheatstone slip are attached to the valves; the other ten are not required for selecting purposes, but are used for shifting the space levers for the first portion of the dash signals.

The typewriter ribbon is fed forward by mechanism, which is actuated by the same cam that actuates the paper slip.

In addition to its forward movement it is given an oscillatory motion, which brings all parts of the ribbon under the letter types in turn, and thus adds materially to its life.

13 shows the four main valves, the block containing the cylinders in which the type bar pistons are actuated, the slide valves and the paper-lifting rack mechanism, whilst 14 shows the main shaft



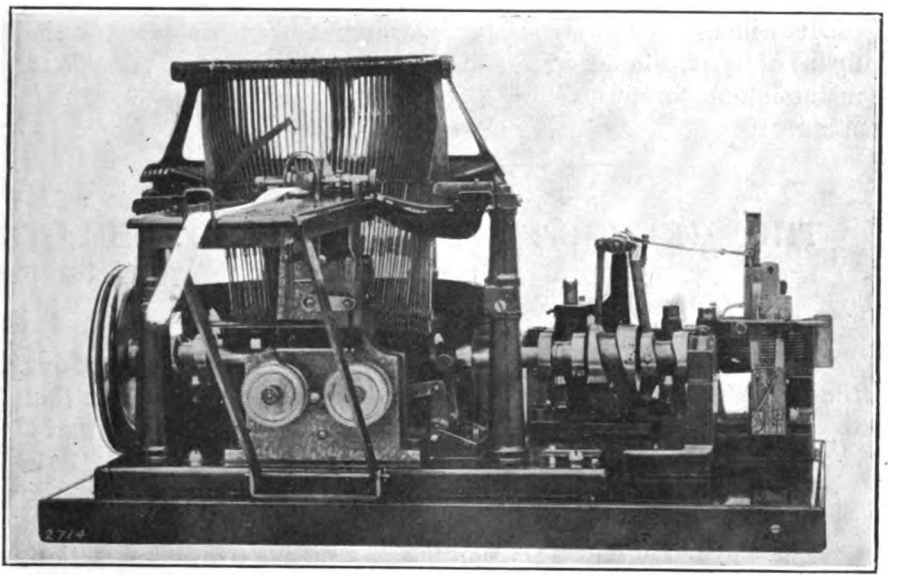
Digitized by Google

with its various cams, the selecting needles, the type levers and the typewriter ribbon feed wheels. The instrument is shown in the act of printing a letter on the Morse slip.

The printer has been experimentally worked at a speed of 128 words per minute, but 100 words per minute is generally regarded as the most suitable speed for reliable working.

The staff required to operate the Creed apparatus is as follows: No. 1, printer and receiver clerk. No. 2, to gum the printed slip on to the message forms. No. 3, checker. No. 4, checker.

These four operators are able to deal with a regular flow of traffic of about 150 to 180 messages per hour without delay.



**14.**—CREED PRINTER. FRONT ELEVATION, SHOWING SELECTING NEEDLES, CAM SHAFT, PAPER FEED, INK RIBBON FEED, ETC.

On the London-Edinburgh circuits there are two Creed receiving perforators and two printers.

The two receiving perforators are connected to two separate circuits with a switch for transposing them as required.

Between the hours of 10 a.m. and 2 p.m., when the received traffic exceeds 200 and sometimes reaches nearly 300 messages per hour, two additional operators (one printer clerk and one gummer clerk) are engaged. Should the flow of traffic necessitate the second circuit being brought into use for a short period, this additional staff is in a position to deal with the overflow as well as relieve the pressure on No. 1 circuit.



Digitized by Google

The following table shows a day's working during a period of pressure:

| Hour. | 9 a.m. to 10 a.m. | 10 a.m. to 11 a.m. | 11 a.m. to 12 noon. | 12 noon to 1 p.m. | 1 p.m. to 2 p.m. | 2 p.m. to 3 p.m. | 3 p.m. to 4 p.m. | 4 p.m. to 5 p.m. | Total. |
|---|---|---|---|---|---|---|---|---|---|
| First circuit . . | 86 | 150 | 210 | 217 | 210 | 132 | 197 | 189 | 1391 |
| Second circuit . . | — | 25 | 123 | 120 | 89 | — | 80 | — | 437 |
| Total messages received | 86 | 175 | 333 | 337 | 299 | 132 | 277 | 189 | 1828 |
| Number of operators | 4 | 6 | 6 | 6 | 6 | 4 | 4 | 4 | 40 |
| Number of messages per hour per operator | 21·5 | 29·16 | 55·5 | 56·16 | 49·86 | 33 | 69·25 | 47·25 | Average for day 45·70 |

It will be seen the operator output per hour has reached the figure of 69·25, so that with skilled operators it would be possible to maintain an operator average of 50 messages per hour.

# THE "KNIGHT" FIRE-ALARM SYSTEM.

By J. J. MARKWICK.

ON a visit to Leicester the writer had the pleasure of inspecting the "Knight" fire-alarm system installed by the corporation in that town, and as the system is comparatively new it was thought that a short description might be of interest to readers of the JOURNAL.

At Leicester "open" circuit working has been adopted, but the patentees claim that a "closed" circuit can be provided if required.

The fire-alarm boxes transmit a code signal to the fire station, which allows several to be placed on one circuit, and a telephone accessible to the public is provided.

The external wiring is on the "radial series" system, two wires being used for each circuit. Two wires are not essential, but they enable a loop test to be made from the fire station and provide alternative means of passing a fire call. Telephoning is also over the two wires in parallel.

## THE FIRE-ALARM TRANSMITTER.

Photographs of the call point apparatus are shown in **1** and **2**, and a diagram of the electrical connections in **3**. The box can be fitted to a wall, lamp-post, or pedestal.

The fire-alarm transmitter consists of a train of wheels, driven by a powerful spring, which is held in check by a cam engaging with



Digitized by Google

the "pull handle" mechanism. The spring is wound by pulling down the lever shown on the right in **2**.

WALTERS ELECTL MFG CO LD
LONDON
FIRE ALARM
33
PULL
KNIGHT'S
PATENT
BREAK GLASS, PULL HANDLE & WAIT HERE
A LOUD BELL RINGS IN THIS BOX WHEN HANDLE HAS BEEN PULLED.
WHEN THE ALARM CALL HAS BEEN RECEIVED AT THE STATION, THIS DOOR
AUTOMATICALLY OPENS & THE TELEPHONE CAN BE USED.

1.—Call Point Box.—Front Elevation.

2.—Call Point Box, with Door Open.

Normally the brushes on the code signalling or character wheel *A* (3) rest on an insulated strip, the remainder of the wheel being metallic and connected to earth. The brushes on wheel *B* rest on small metal plates, the rest of its periphery being insulation.



Digitized by Google

When the handle is "pulled" the trainwork is set in motion, and the wheels *A* and *B* immediately revolve sufficiently to allow the brushes on the former to be put to "earth" and those on the latter to be disconnected. The trainwork cannot revolve further until a current has passed through at least one coil of the electro-magnet, *C*, and by this means confusion of signals at the fire station is prevented, if two or more boxes are pulled at or about the same time. This matter will be referred to again later.

Assuming that no other box on the system is signalling and a current passes through *C*, then *A* will revolve twice and *B* once for each pull of the handle. The function of *B* is to cut off all boxes on the "down" side of the circuit and also the telephone in the box actuated, until the code signal has been transmitted twice to the fire station. The door of the containing box is then opened automatically by the cam on the winding mechanism withdrawing the latch.

The pull handle is of the non-interference type; that is, it does not matter if the person giving an alarm hangs on to it or gives a number of separate pulls; the trainwork, having started, is unaffected until it has twice sent the code call to the station.

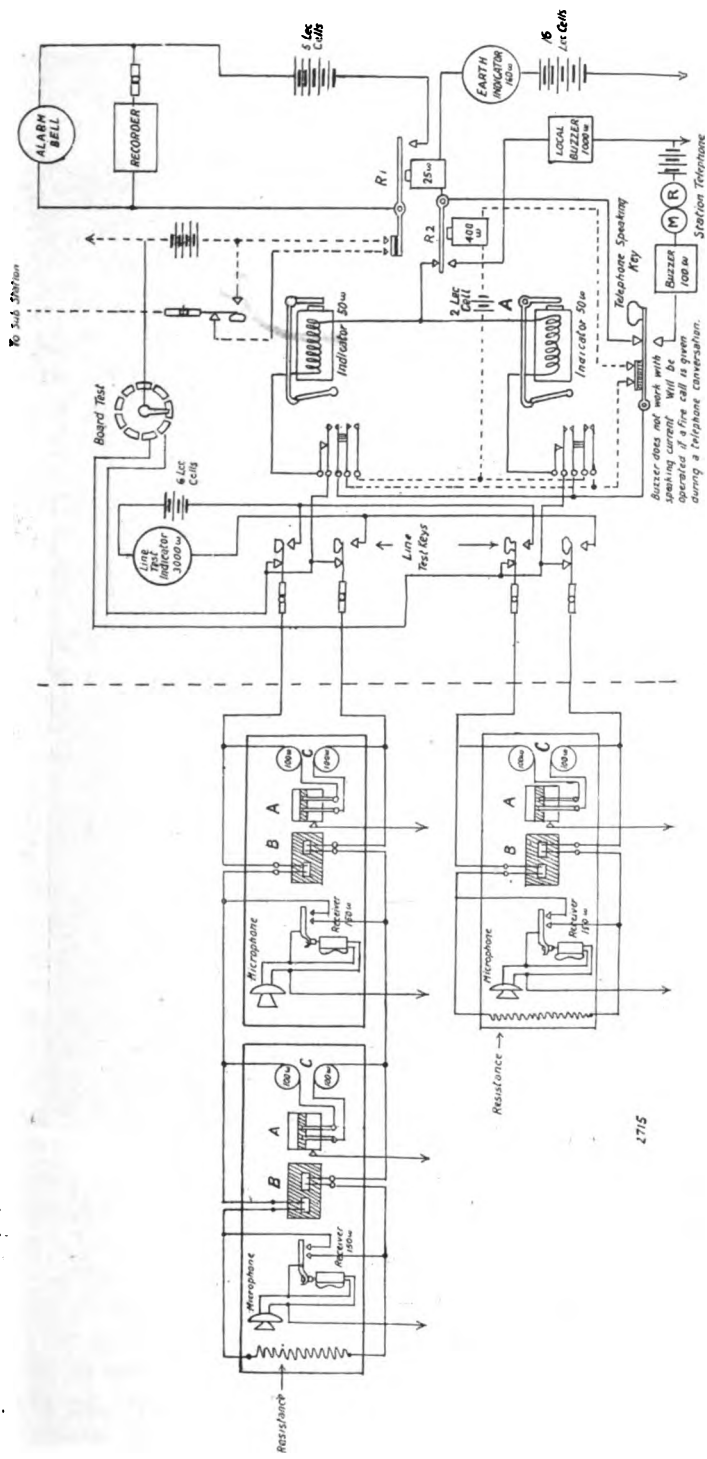
In addition to driving the chain of wheels and opening the door of the containing box, the spring also rings a loud-sounding mechanical bell. This local alarm is intended to draw the attention of passers-by, or the police, to anyone giving a malicious call.

If, when the handle is pulled, another box on the same circuit, but nearer to the fire station, is signalling, the second call will be held up by the armature of the electro-magnet, *C*. When the box nearer the fire station has completed its call, its earth connection is automatically taken off and the lines are put through to the boxes beyond. A current can now pass through *C* of the second box pulled, and its call will be transmitted to the fire station. A second call from a box nearer to the fire station cuts out the one already signalling and sends in its own call. The first call, however, is not lost. If the character wheel *A* has completed one revolution before the second box is pulled, the code signal has been transmitted to the fire station and the mechanism returns to the normal. If one revolution of *A* has not been completed the armature of the electro-magnet *C* will hold up the trainwork until a current again passes through its coils; *A* will then be released and one complete set of signals transmitted.

The handle, when pulled, remains extended, and cannot be restored to normal, except by winding the spring, which should be done by the fireman when renewing the glass front of the box. If this is omitted the projection on the inside of the door, just below the lock, will foul the drum of the driving spring and prevent the



Digitized by Google

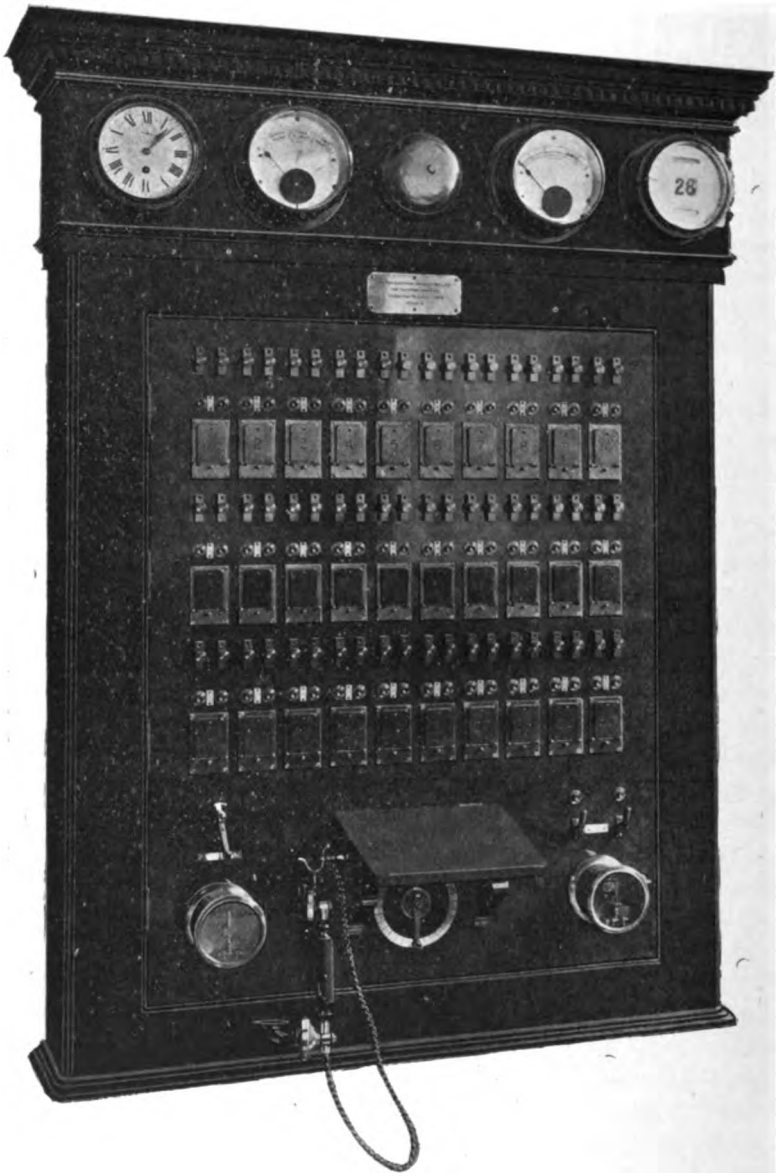



3.—KNIGHT FIRE-ALARM SYSTEM. ELECTRICAL CONNECTIONS. CALL POINT CIRCUITS SHOWN ON LEFT, STATION WIRING ON RIGHT OF VERTICAL DOTTED LINE.



Digitized by Google

door closing. At the same time the glass front is splintered by the pull handle.




4.—Station Indicator Board. Front Elevation.

## Station Apparatus.

Photographs of the indicator board are shown in 4 and 5 and a diagram of the connections in 3.



Digitized by Google

With the exception of the indicator, special reference to the apparatus fitted is unnecessary, as it is of a type familiar to readers of the JOURNAL.

Two photographs of an indicator are shown in 6. It is of an ordinary drop pattern, the special feature being the commutator fitted at the back. The dropping of the shutter breaks one and makes two contacts, as shown in 3.

As previously mentioned, if the handle of a fire-alarm transmitter is "pulled" the two lines are "earthed." This causes the main battery to send out a current through the "earth indicator," the coils of relay *R1*, the armature of relay *R2*, the coils of a drop indicator, according to which circuit the box actuated is on, and the top contacts of the indicator locals, to the lines. Immediately the indicator shutter drops a current from the local battery *A* passes through the coils of relay *R2 viâ* the fourth and fifth contact springs of the indicator, and the telephone speaking key. The armature of relay *R2* is attracted and the main battery now has two paths, one from the coils of relay *R1* to the telephone speaking key, and the second and third contacts of the indicator local to the lines, the other through the local buzzer to earth.

Relay *R1* responds to the makes and breaks of the character wheel in the fire-alarm transmitter, the distinctive signals being announced on a loud-sounding trembler bell, and recorded on a self-starting Morse inker.

The local buzzer is to prevent a shutter being allowed to remain down unnecessarily.

As long as the armature of relay *R2* is held down the main battery is cut off from the indicator circuit and all lines, except the one on which a box is signalling. It will be remembered that the trainwork of the fire-alarm transmitter is held up until a current passes through the electro-magnet *C*, so that if a box on another circuit is now "pulled" it will await the restoration of the indicator first dropped, and interference between circuits is prevented.

To speak on the telephone the "telephone speaking key" has to be held and the indicator allowed to remain down. The speaking key disconnects the local battery from relay *R2*, its armature remains up, and the main battery is available to the other circuits.

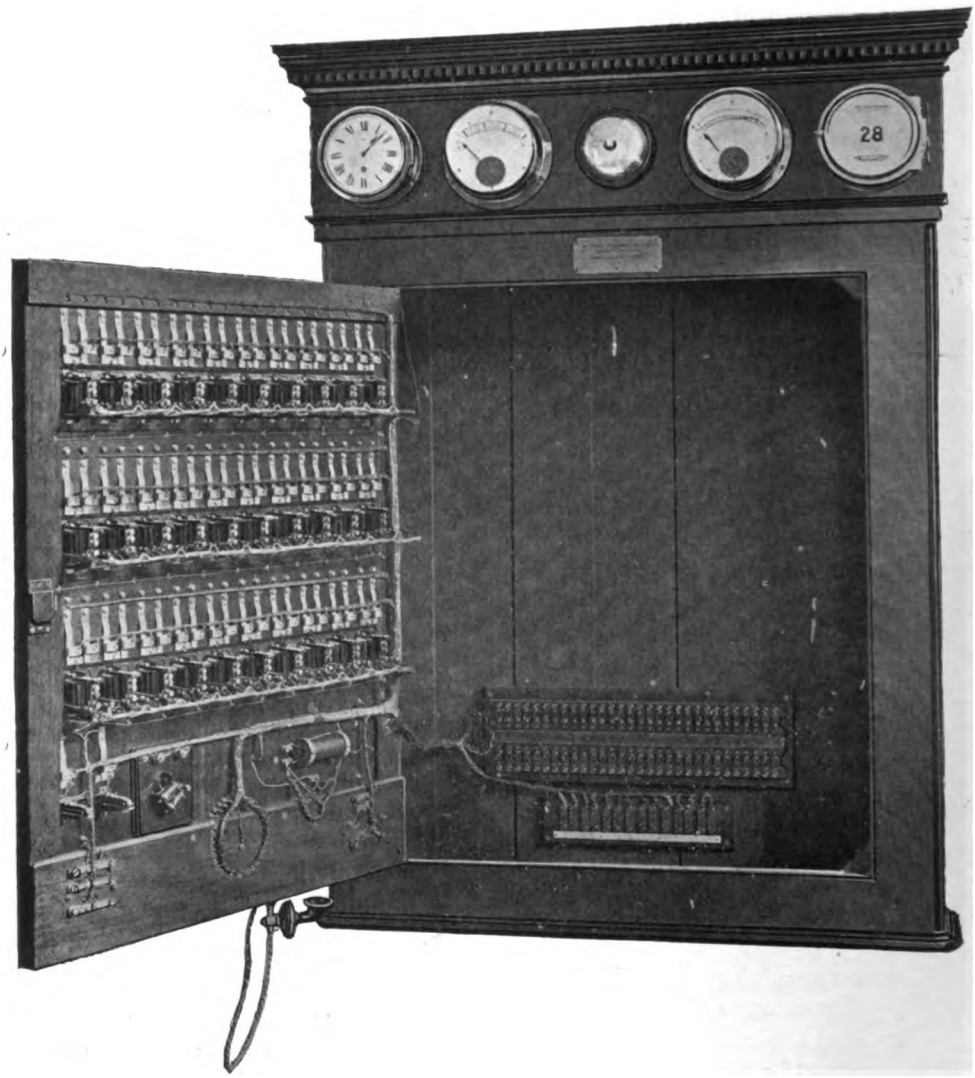
Should a fire-call be given on another circuit during a telephone conversation, a second indicator shutter will be dropped, and if this is not observed by the attendant the buzzer in the telephone circuit will be operated, due to the increased current sent out by the telephone battery. The telephone speaking-key should be immediately released and the first indicator restored; the fire call will then be received.

A fire call from a box on the circuit on which a telephone con-



Digitized by Google

versation is proceeding will also operate the buzzer in the telephone circuit. If the fire call is given at a box nearer to the fire-station, all boxes beyond it will be cut off, and the restoration of the tele-




5.—Station Indicator Board with Door Open to show Wiring.

phone speaking-key at the station is all that is necessary. A fire call from a box beyond the one being used for telephone purposes will be transmitted to the fire station immediately the telephone receiver at the intermediate box is placed on the hook.

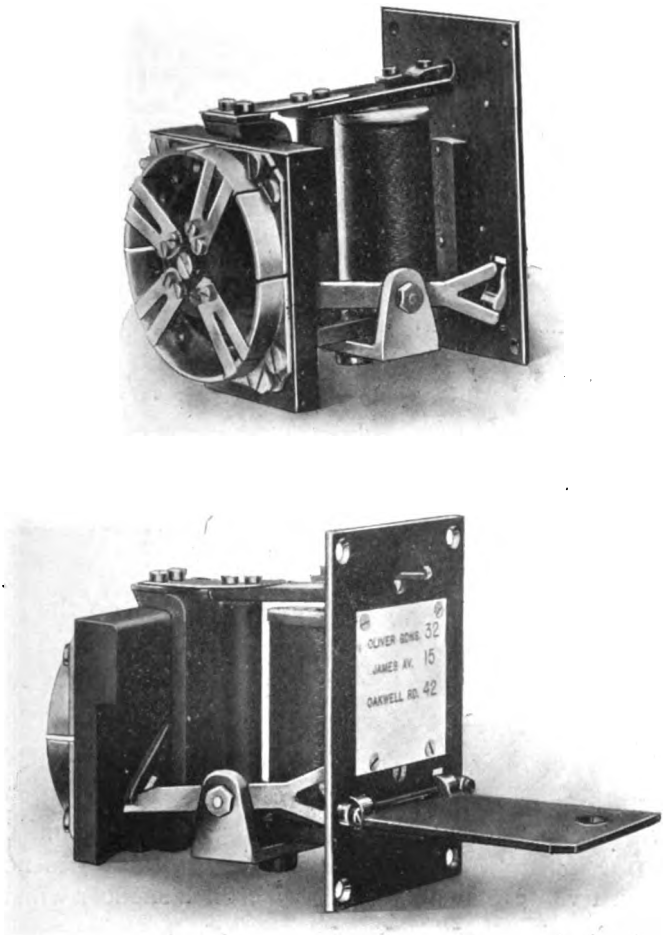
Should the person using the telephone fail to restore the receiver,



Digitized by Google

the second call will be stored until the brigade arrives at the intermediate box in response to the fire call, which must be given before an unauthorised person can gain access to the telephone.

If more than one box is fitted on a circuit a self-starting recorder




**6.**—Station Circuit Indicator.

is essential, and in all cases its use is desirable as a record of a call is then obtained.

A coil of high resistance is placed at the distant end of each pair of wires, so that tests for continuity and short circuit may be made by depressing the "line test keys" and taking the readings on a milliampère-meter, shown in 3 as a "line test indicator." A disconnection on one wire, or a short circuit, do not affect the working of the system.



Digitized by Google

An earth will be shown on the milliampère-meter marked "earth indicator" on the diagram.

The switch marked "board test" is for testing the station apparatus.

In conclusion, the writer has to express his indebtedness to the Institution of Electrical Engineers for permission to publish the photographs; to Messrs. Powles and Moore, of the Walters Electrical Manufacturing Co., who kindly supplied the diagrams, blocks, and particulars of the apparatus; and to Mr. Neal, Chief Officer of the Leicester Fire Brigade, for the facilities given at the time of visit.

[*It is only fair to Mr. Markwick to state that the foregoing article was written prior to the publication of Mr. Moore's paper on the subject by the Institution of Electrical Engineers.*—EDS. POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.]

# CORRESPONDENCE.

## SOUNDER SILENCERS.

WE have received the following interesting letter on the subject of sounder silencers from Cape Colony:

TELEGRAPHS,
BEAUFORT WEST,
CAPE COLONY.
*February 18th*, 1913.

SIR,—As the article on Silencer No. 3 in the JOURNAL for January, 1913, appears to imply that an ideal silencer has not yet been evolved, I venture to forward a note on a silencer which has been tried here.

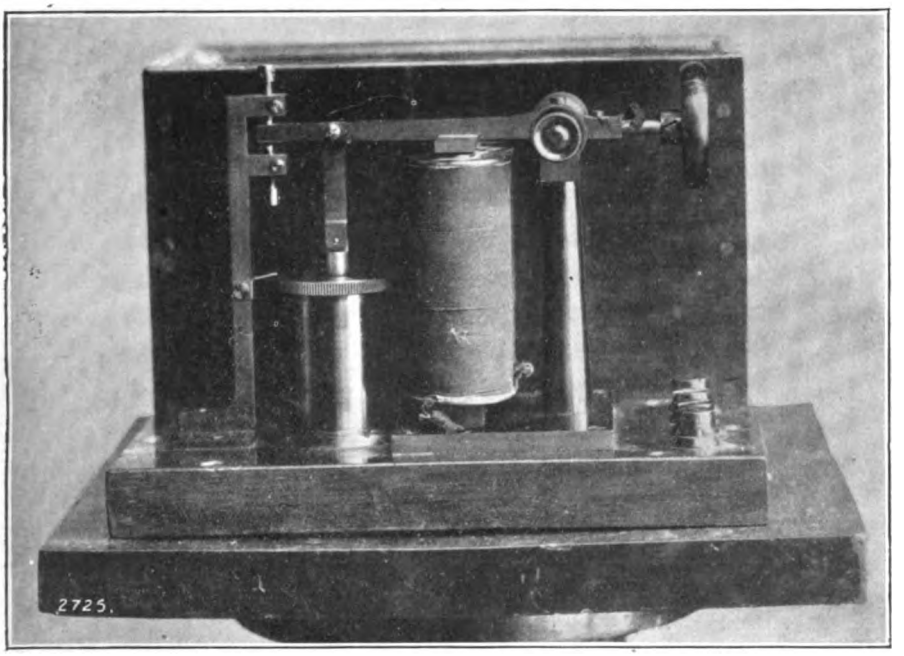
The instrument shown in 1 and 2 is a "call device" made by Elliott Brothers, which was used on the Eastern Telegraph Company's repeater here.

It is practically a sounder of 4000 ohms resistance, the spring replaced by an adjustable weight, and the descent of the armature retarded by a plunger which has to force Rangoon oil from an inner to an outer cylinder through an adjustable channel. The oil can return to the inner cylinder through a ball-valve, so that the upward movement of the armature is not hindered.

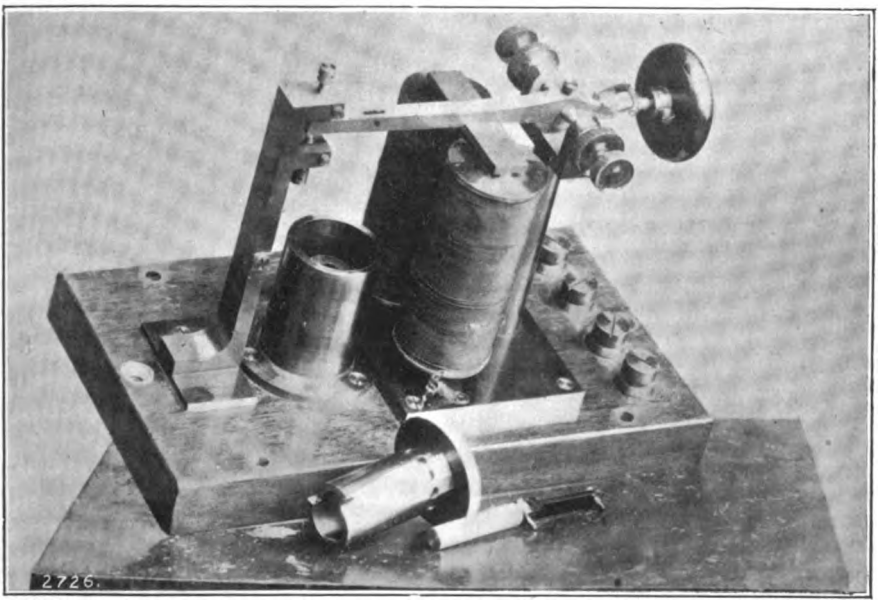
The outward flow of the oil is controlled by the cylinder, the milled head being turned round a vertical axis, and an alteration



Digitized by Google




**1.**—Sounder Silencer. Side Elevation.

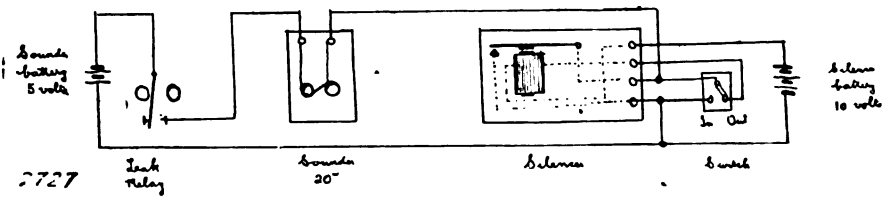



**2.**—Sounder Silencer, with Plunger removed from Oil Cylinder.



Digitized by Google

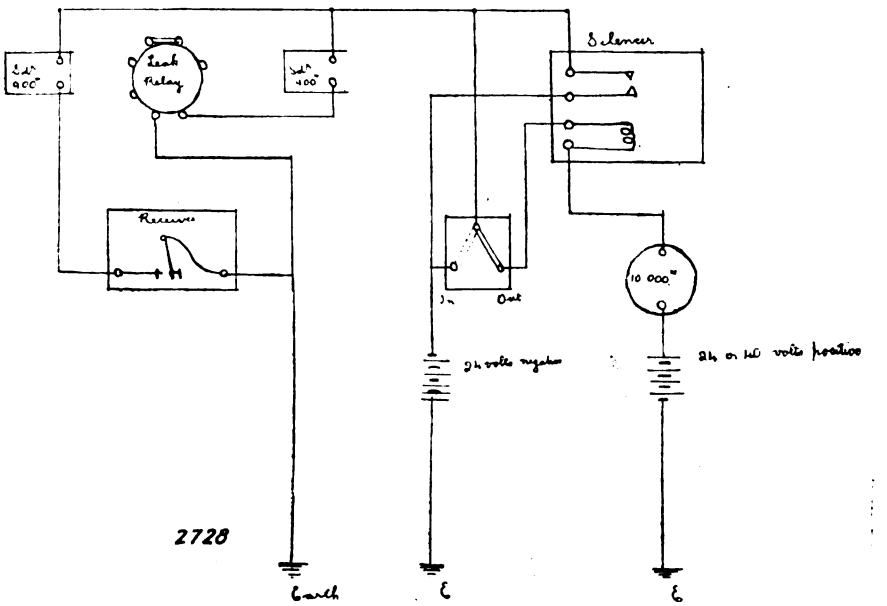
in the time of descent of the armature is thus a simple matter. This instrument formed part of the repeater leak-circuit, and did not respond to the short beats of the cable code, but was adjusted so that when either the dot or the dash key was depressed for about




3.—Connections of Silencer on Repeater Leak Relay.

two seconds the armature descended, closed the bottom contact, and so rang a trembler bell, thus indicating that the repeater clerk's attention was required. The upper contact is insulated.

The repeater is now being converted to an ordinary fast repeater,




4.—Suggested Arrangement for Secondary Cell Installation.

and the suggestion was made that this call device might do duty as a silencer.

This was accomplished by connecting it up as shown in 3. When the sounders are "out" and the leak relay is marking, the sounder and silencer batteries combine to send a current through the sounder and silencer in series. This current is too weak to work the sounder, but if prolonged for the necessary period will cause the



Digitized by Google

silencer armature to descend and make its contact. This contact closes the silencer circuit through its own battery and coil, so locking the armature in its depressed position and at the same time completing the sounder circuit, and the sounders may now be heard. The silencer works well. It can be adjusted to actuate the sounders in five seconds and yet keep them out to ordinary working, nor does the period to which it has been adjusted vary.

The Rangoon oil keeps good for years. 4 is a suggestion for connecting it to a secondary cell installation.

A two-way switch is provided which, when turned to the "In" position, completes the sounder circuit and disconnects the silencer battery. When a call is received the repeater clerk should turn the switch to the "In" position, though this is not absolutely necessary.

The silencer armature rises and falls very gently when working signals are passing.

Yours faithfully,
R. WATSON.

## LONDON DISTRICT: PNEUMATIC TUBES IN THE CENTRAL TELEGRAPH OFFICE.

THE work of principal magnitude engaging the attention of the Engineering Staff at the Central Telegraph Office at present is the provision of a new equipment of pneumatic tubes on the continuous "Dudley" system. The estimate provides for the installation of some 27,000 feet of 2½-inch brass tubing, which is being hung from the ceilings of the various galleries in symmetrical runs. The displacement of the old system with its heavy sluice valves and "D" boxes will involve the recovery of some seventy tons of metal. Some of the new tubes have already been brought into use, and they give flattering indications as to the extent to which the communication facilities will be improved and time and labour economised.

POWER WIRING.—The re-wiring of the power leads which was in progress at the time of the lamentable outbreak of fire at the Central Telegraph Office has now been completed and there remains no vestige of the old "V.I.R." cable. The power circuits are in lead-covered cables throughout the building, with special distribution switches on each floor, and, of course, the usual and adequate fusing provision in connection with the various sections.

BUCKINGHAM PALACE CONNECTED TO QUEBEC.—By Royal request a special press button was fitted on June 3rd in the boudoir of Queen Mary at Buckingham Palace and connected to Quebec so that the Queen might open a Hospital there by electrical signal. The Commercial Cable Company's line was used across the Atlantic; the signal was successfully given and acknowledged by a return signal, which was received within fifteen seconds.



Digitized by Google

## THE RAVAGES OF THE WHITE ANT.

My interest in the white ant and its doings dates from an early period in my telegraphic experience. It had its origin in the frequent references in technical text-books to the deadly effects of the white ant on telegraph poles, and was greatly stimulated by descriptive accounts sent me by a colleague who accepted a post with the Eastern Telegraph Company and was stationed in a district infested with the white ant. How far it is shared by telegraph engineers at home I cannot say, but from the various inquiries which my correspondence brings I judge that my interest or curiosity in the subject is not uncommon amongst British engineers, whilst to my professional brethren in many countries abroad the white ant is a subject less of curiosity than of anxiety.

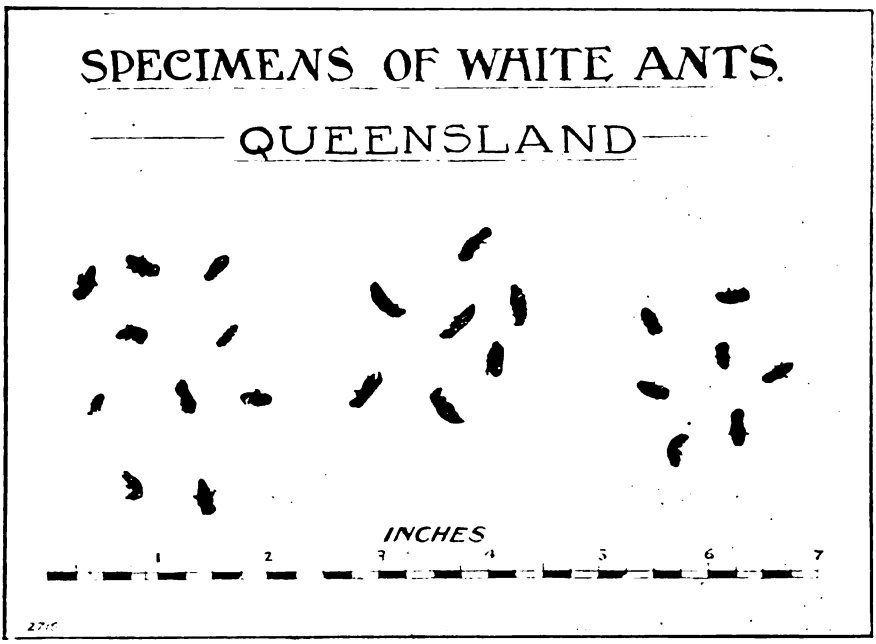
In common with most telegraph engineers, I knew that the white ant was an exceedingly destructive insect, working havoc with timber in general and with telegraph poles in particular. As to the exact method of attack and effects produced I was a little uncertain. But until quite recently I shared the common belief that so far as the telegraph engineer was concerned timber was the only object of attack. That lead-covered P.C. cables, lying in earthenware ducts in the heart of a city, should also be subject to serious damage from this formidable pest was never dreamt of in my telegraphic philosophy, and, so far as I am aware, technical literature contains no reference to the subject. Yet, as the facts subsequently stated show, this is exactly what happened, and the case adds a new and subtle terror to this telegraphic pest of the tropics and Southern Hemisphere generally.

Before entering into details of the case a few particulars as to the white ant and his ways may be of interest. 1 shows a few



Digitized by Google

specimens of the larger white ant (*Termes Australia*; family, Termitidæ) found in Northern Queensland. Like all other members of the ant family they well deserve the high enconium on their industry passed by that wise observer, King Solomon. They work ceaselessly, and many a telegraph engineer wishes they would observe at least an occasional Sabbath. They appear to have much the same highly developed communal organisation as their black brethren, so fascinatingly described by Lord Avebury, but they are necessarily more restricted in their travels and mode of life. They congregate




I.—Specimens of White Ants.

together and live in nests or hives which in structure are not unlike those of the bee, except that instead of being made of wax they are formed of a brown excretion exuded from their bodies. In appearance it is very like a brown cement. It also possesses some of the same properties as cement, and is often dug up, levelled, moistened and rolled out, and thus converted into excellent cricket-pitches and tennis-courts. In the "out back" regions it is even used for floors.

The nests, honeycombed with cells, each with its busy occupant, may either rest on the ground or be formed with the wood or other substance attacked as a base, or the ants may enter the timber below the ground surface and proceed to reduce it to a dry powdery substance, filling it with their brittle cells as they proceed.



Digitized by Google

**2.**—NESTS OF THE WHITE ANT.



Digitized by Google

**2** shows the immense height to which these nests are sometimes built. In the case shown it may be stated that the nest (beside which the horseman is standing) has reached up to the wires, which the ants thereupon proceeded to enclose. The height above ground of this particular nest was 32 ft. Needless to say, the result of their activity in this case was that the wire was as effectively earthed as though attached to an earthplate. This, however, is a somewhat exceptional case, and is doubtless due to that prodigality of insect life and energy found in most of the States under the Southern Cross. For, amongst the many gifts which a bountiful Providence has showered down upon this vast Australasian territory, and especially upon Queensland, a superabundance of insect life is amongst the most bounteous. Doubtless they all have their uses and their advantages, but to the harassed telegraph engineer the latter are not always apparent. I have just passed through a district in Northern Queensland where fine healthy-looking spiders weave large fantastic webs across the wires and send out multitudes of long trailers to the ground, whilst their neighbours are busy enveloping the insulators with the same gossamer product. If in despair the engineer puts up a lead-covered aërial cable, a voracious boring beetle rewards his effort by boring neat round holes about the size of a pin-head in the sheathing. In comparison with the white ant, though, these are minor troubles, and in any case are a digression from the subject of this present article.

The rate of destruction due to white ants depends in large measure upon the nature and hardness of the wood. Coniferous woods such as pine, larch, fir, etc., are attacked and rapidly destroyed. Poles cut from these softer woods would be reduced to a powder within three or fourth months of erection, and nothing but a fragile shell would remain. Australia, however, produces comparatively few of these timbers. The harder woods are more abundant, such as iron-bark, bloodwood, stringy bark, cypress pine, and the various gums, and these better resist the attack of the white ant.

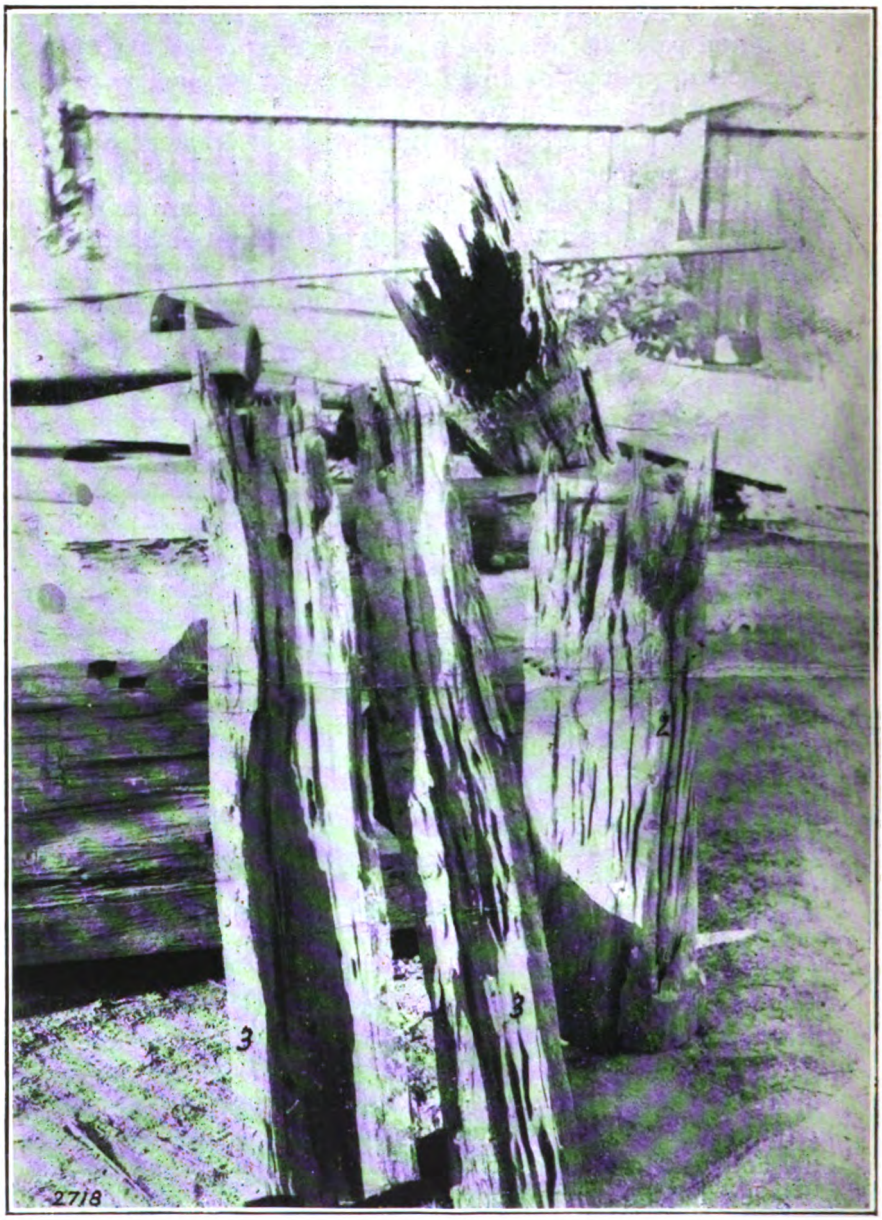
**3** shows a pole recently recovered from the streets of Townsville (Queensland), and the picture gives a fairly good idea of how the hardwood pole is reduced to a mere shell.

There are several methods by which poles are rendered immune from the disintegrating attentions of the pest. The one adopted usually and with most success is to poison the pole by boring an augur hole $\frac{5}{8}$ in. or $\frac{3}{4}$ in. in diameter, 18 in. above and 18 in. below ground level. The holes are bored in a downward direction to the centre of the pole with a slope of about 45° and are filled with a solution of arsenic and caustic soda (1 lb. arsenic to 2 lb. caustic soda, and 1 gallon water). The holes are then plugged with wood



Digitized by Google

to prevent evaporation, and in addition the base and lower portion of the pole is well painted with the poisonous mixture. Other




3.—Recovered Pole, showing the Shell to which Timber has been Reduced.

methods employed consist in setting the pole in concrete, or fitting it into a C.I. base, removing the sapwood and charring the base, etc.,



Digitized by Google

but these are more costly and generally less efficient means of protection.

The above, however, are the more or less familiar facts of the subject, but by the kind permission of the Postmaster-General of the Australian Commonwealth I am enabled to furnish the following particulars of a case of serious damage to lead-covered cables by these insects. The damage was first revealed in September, 1911, when faults developed in a 104-pair L.C. P.C. cable lying in an earthenware duct in the streets of Adelaide. The conduit was one of a 6-way earthenware duct laid down in December, 1906, and the

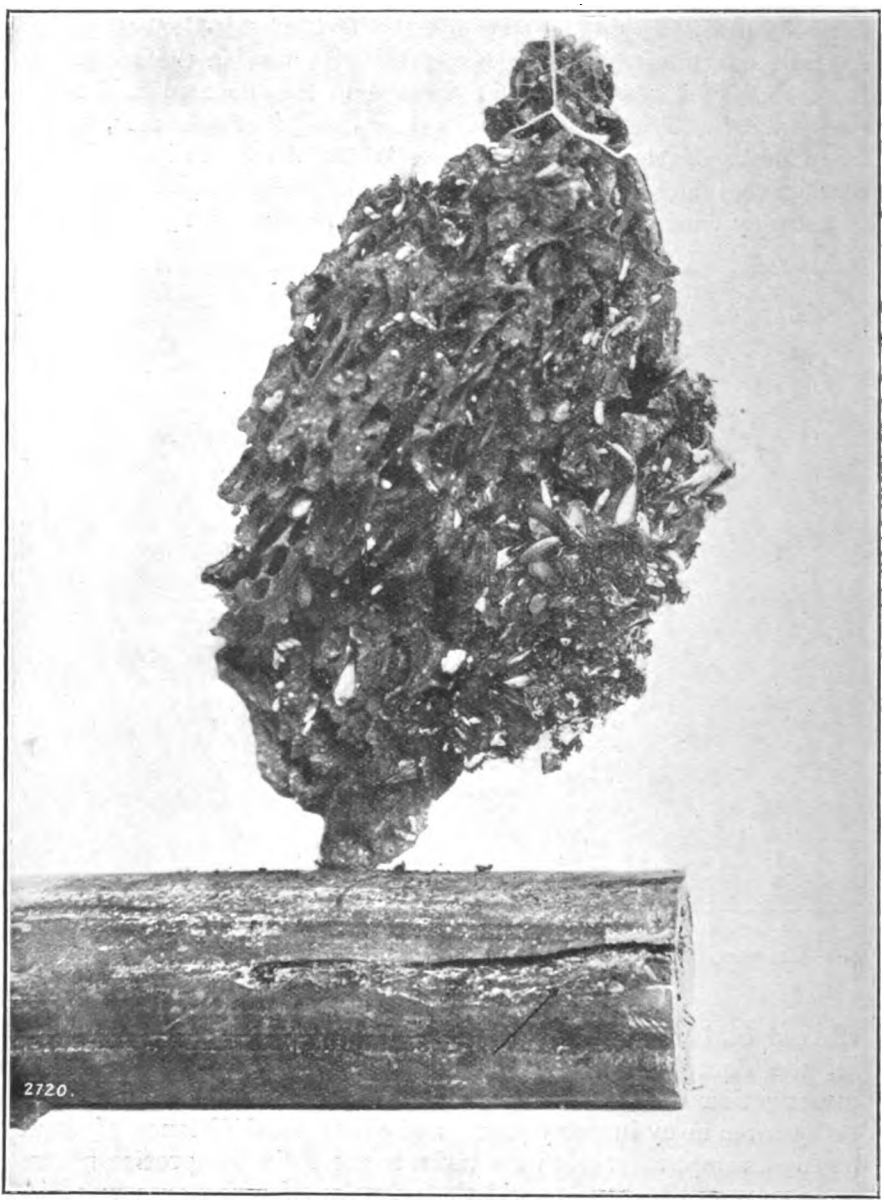
4.—A Street in Adelaide where Lead Sheath of P.C. Cable was Destroyed by Ants.

affected cable was drawn in in February, 1907. Prior to drawing in, the duct had been swabbed out in the usual way. When investigation was made it was found that the lead sheathing was badly eaten away in many places and over a total distance of about 20 ft. Prompt measures were taken to ascertain the precise nature and extent of the damage, and the presence of white ants was discovered in several portions of the Adelaide underground system. In no other case, however, was the insulation of the cables affected. When the faulty cable was withdrawn the usual brown excretion of white ants was found adhering to it. 4 is a view of the scene of the occurrence. The damage occurred near the base of a red



Digitized by Google

gum pole (which for better protection from the termites had been set in concrete) and about sixty feet from the nearest manhole.




5.—A Piece of the Butt of the Pole adjacent to Damaged Duct.

In this manhole certain wooden plugs fitted into spare ducts were found infested with the ants, as was also a length of Jarrah troughing



Digitized by Google

containing electric light mains. 5 shows a piece of the wood taken from the butt of the adjacent telegraph pole. It was at first difficult to determine by what means the insects had obtained access to the cable duct at this point, as the ducts had been laid on a bed of 4 in. concrete and both sides and top were protected by concrete 3 in. thick. Further investigation revealed a crack in the concrete, and it was apparently through this crack that entrance to the ducts had been gained. Once inside, the heat of the asphalte pavement would be conducive to their multiplication.

As has been stated only one cable was affected, but as the termites had been found in more than one manhole and the matter was far too important to permit of any risks being taken, special action was set on foot to deal not only with the duct affected, but all other duct routes where the least sign of the pest was visible. The ends of the ducts were sealed with clay, and fumes of carbon bisulphide were pumped through. In order to test the efficacy of the fumes a glass jar partly filled with decayed wood and containing some white ants was placed in an intermediate manhole and the fumes applied until the insects had all perished. This treatment has proved successful, but having regard to the fact that white ants have also been found in the cable conduits in Perth, and that not very long since they attacked the lead sheathing of a tramway feeder cable enclosed in wood troughing in Sidney, close search is now made in all the Department's manholes whenever these are opened for any sign of the presence of white ants.

It was at first thought that the lead sheathing had been destroyed by the cutting action of the insects' mandibles, but subsequent analysis tends to show that the damage was probably caused by formic acid deposited on the cable sheathing by their operations. In any case the significance of the incident will not be lost upon telegraph engineers who are responsible for the maintenance of lead-covered cables in districts infested with the white ant, and to whom hitherto they have been regarded as destructive only to poles and ground timber. J. M. C.

---

## MULTIPLE WAY DUCT-WORK.

By J. WHITEHEAD.

THERE is, at present, every indication that the use of multiple way ducts, in preference to C.I. pipes, will become general in connection with the Department's large underground schemes, where more than one pipe would be necessary.

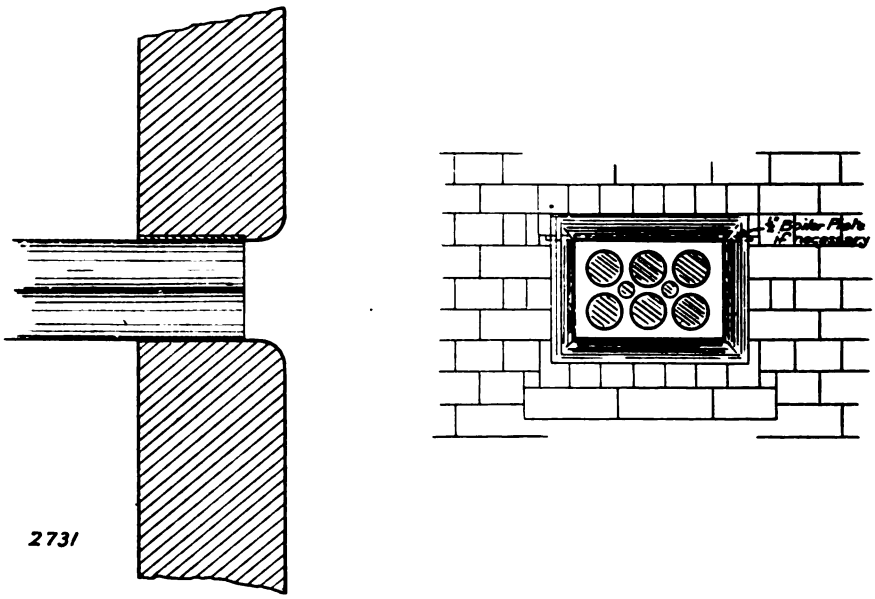
A very large scheme, known as the London-Aylesbury-St. Albans



Digitized by Google

underground route, has just been completed on which these ducts were used. The total trench mileage is approximately fifty miles. The ducts used vary in type, according to the local requirements, the route near London being 9-way, reducing to 2-way beyond Watford. Occasional 3-way and 6-way sections were laid to accommodate local telephone cables.

The route is intended to carry "loaded" cables, and manholes to take the loading coils have been constructed, spaced 4078 yards apart. Specially large manholes are required for these purposes, and types known as F 8 (footway special), internal dimensions 8 ft. by




I.—Sketch showing the Recessing of the Ducts in Smaller Manholes and Double Junction Boxes.

5 ft. 6 in. by 6 ft., and C 8 (carriage way special), internal dimensions 7 ft. by 7 ft. by 6 ft., have been built.

In the 9-way sections the jointing chambers consist of F 5 or C 4 and other large type manholes. In the 6-way sections F 2 and C 2 manholes have been built, and in the 3- and 2-way sections double junction boxes are placed under all made-up pavings, buried jointing couplings being used under inexpensive pavings, such as gravel, ordinary macadam, and under grass margins.

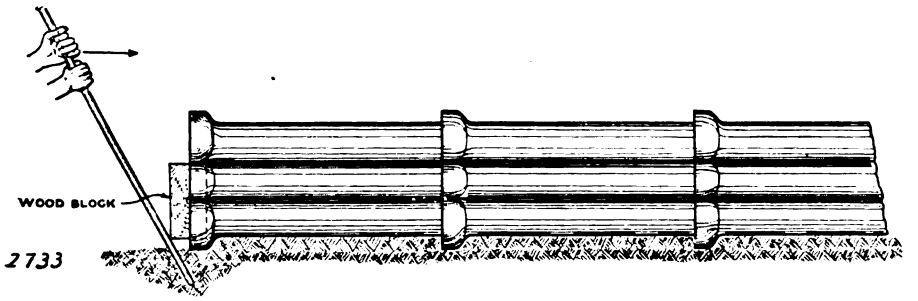
The internal length of a C 2 manhole is 4 ft. and of a F 2 manhole and double junction box 4 ft. 3½ in., which does not allow sufficient room for jointing main cables with the standard 2 ft. sleeves. As there are no terminating pieces or their equivalent supplied with multiple way ducts, when the work was arranged the



Digitized by Google

question arose as to whether it would not be necessary to build larger jointing chambers to allow of sufficient jointing room. The difficulty, however, was overcome by what is known as "recessing," *i.e.* terminating the ducts, 4 in. or more, in the brickwork of the chambers in the manner illustrated in the sketch (1). The top, and side edges of the bricks at the end of the recesses, are chamfered and rendered with cement, which gives a smooth run for the cable drawing-in rope.

The ducts are made of brown stone-ware well burnt and glazed. The ordinary duct is 2 ft. 6 in. long with spigot and socket ends, lined with Stanford's compound to ensure a true fit. This compound consists of tar loaded with limestone dust and sulphur. The lining adheres so firmly to the stone-ware that it cannot be removed without taking some part of the stone-ware away with it. The spigots and sockets present a well-finished appearance and fit




2.—Jointing and Aligning the Ducts.

accurately and closely; the depth of the socket is $1\frac{3}{4}$ in. and the spigots $1\frac{1}{2}$ in.

The ducts are issued with a red paint mark on that side of the duct which must be face upwards, and a black paint mark on the side which should rest on the bottom of the trench. Instruction to this effect is given by means of an adhesive label pasted on occasional ducts by the maker. It is very important that this instruction be observed, or true alignment will not be obtained, and the ducts will show a tendency to twist and fail to lie perfectly flat in the trench.

In preparing for the laying of the ducts, the trench in all cases should be well rammed, so as to make a firm bedding for the conduits, and at all points where the sockets rest, the trench should be scooped out, so that the body of the duct rests upon solid ground. The depth of the trench is specified in the contract for each particular case; generally it is 18 in. under footways and 2 ft. under roadways. There are, of course, circumstances where additional depth is necessary, but these cases are left to the discretion of the supervising officer. The line must be kept as straight as possible. If it is necessary to deflect from a straight line a slight



Digitized by Google

"set" may be given to the joints. With regard to the "set" experience has shown that not more than $\frac{1}{8}$ in. per joint should be given. Anything greater leaves the joint open and admits of the free ingress of water. This "set" gives a deflection of approximately 1 ft. in ten ducts, for $8\frac{1}{3}$ yards; for most purposes this is found to be enough.

In making the joints, the linings of the spigots and sockets should be well luted with the jointing mixture or compound. The first mixture used, consisted of four parts resin and one part Russian tallow boiled together and applied hot by means of a brush. Afterwards a mixture, consisting of eleven parts Canadian tar to nine parts vegetable pitch, was tried; both these mixtures have, however, been superseded by a compound of coal-tar, French chalk and palm pitch, which gives very satisfactory results. It is essential that the surfaces of the linings be thoroughly cleaned before the luting mixture is applied. The ends of the ducts having been served with the luting mixture, the spigot end of the duct to be laid is thrust into the socket of that already set in the earth and forced home. This is done by means of an iron bar used as a lever, with a piece of wood inserted between the end of the duct and the bar, to take the thrust (2). It is very important that close attention be given to the jointing. The ducts must be properly forced home, and where possible laid in true alignment. Only one duct should be laid and fixed at a time, not a series of two or three. When a "set" has to be given the face of the joint should be thoroughly plastered with the jointing material used.

At buried joints in the 2- and 3-way sections, stone-ware jointing couplings were used. Each "coupling" consisted of five pieces of stone-ware in all—viz. four splits, and one double spigoted duct. Pending the making of the joints in the cables, these couplings were sealed with clay round the flanges of the splits, but when permanently sealed hot bitumen was used. It has since been found, however, that these couplings are not sufficiently strong and they have now been superseded by cast-iron couplings.

Each completed section is tested by drawing through an iron mandril $9\frac{1}{2}$ in. by $3\frac{1}{8}$ in. and a piece of 3-in. lead cable 6 ft. long.

As the ducts are laid it is usual to draw an iron mandril through each hole, so that the contractor can detect at the outset any defective alignment, which would be much more difficult to remedy if left until the section was completed, as the removal of the obstruction would then entail taking out and replacing a larger number of ducts. By lifting the ducts into the form of an arch the top duct can be removed. When restoring the ducts great care should be taken to re-lute all joints which have been disturbed.

The next illustration (3) shows an arrangement which is usually adopted by contractors in working the mandrils through as the



Digitized by Google

work proceeds. A portable wooden framework carrying reels to the same number as bores or holes in the new duct line is

3.—9-way Duct with Reels and Ropes for passing Mandril forward.

fixed over the opening from which the work is proceeding. The reels are fixed on spindles to move freely, and carry a sash-line or thin rope, the free end of which is attached to the mandril drawn from duct to duct as they are laid; the mandrils are drawn

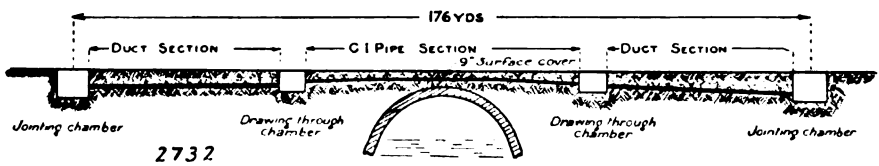


Digitized by Google

forward by means of an iron rod 2 ft. 6 in. long, with a small hook at the end. This, the duct-layer inserts into the conduits, hooks the eye of the mandril, and pulls it through. The rope pays out from the reels without any attention being required. When the length or section is completed the mandrils are withdrawn and the rope is used to draw in a stouter one for pulling through the standard mandril and test piece of cable. The latter is drawn through without any lubricant, and is quickly reduced in diameter. It is therefore necessary to replace it by a fresh piece fairly frequently. A stock of test pieces should, therefore, be kept at hand for the purpose. After passing through about fifteen lengths, the test cable is usually reduced about $\frac{1}{8}$ in. in diameter and a fresh test piece is necessary.

The ducts are requisitioned and supplied in lineal yards.

In addition to the regular $3\frac{1}{4}$-in. holes in the large ducts there are small holes $1\frac{1}{2}$ in. in diameter, four being in the 9-way size and two in the 6-way. These small holes will take cables up to $1\frac{1}{4}$ in. diameter.




4.—Crossing a Culvert.

Care is necessary in handling the ducts to avoid breaking the socket flanges, which are easily damaged. All ducts chipped or fractured are discarded.

The ducts do not lend themselves to the easy negotiation of bridges, culverts, and other obstructions of a similar nature, especially if the depth of cover is small. In such circumstances the difficulty may be overcome by inserting a short section of iron or steel pipe as shown in 4, suitable drawing-through chambers being built on each side to admit of standard length of cable being drawn through. It is found that, generally speaking, these bridges or culverts, which are not infrequent on provincial main roads, are constructed with two $4\frac{1}{2}$-in. ringed arches, and, on account of the heavy nature of modern road traffic, cutting through them is inadvisable.

The width of trench for 2- and 3-way ducts is 18 in., ditto for 6-way in two lines of three, and for 9-way 24 in.

| | cwts. | qrs. | lbs. | |
|---|---|---|---|---|
| Weight of 9-way ducts is | 1 | 2 | 0 | each |
| ,, 6-way ,, | 1 | 0 | 10 | ,, |
| ,, 3-way ,, | — | 2 | 14 | ,, |
| ,, 2-way ,, | — | 1 | 19 | ,, |



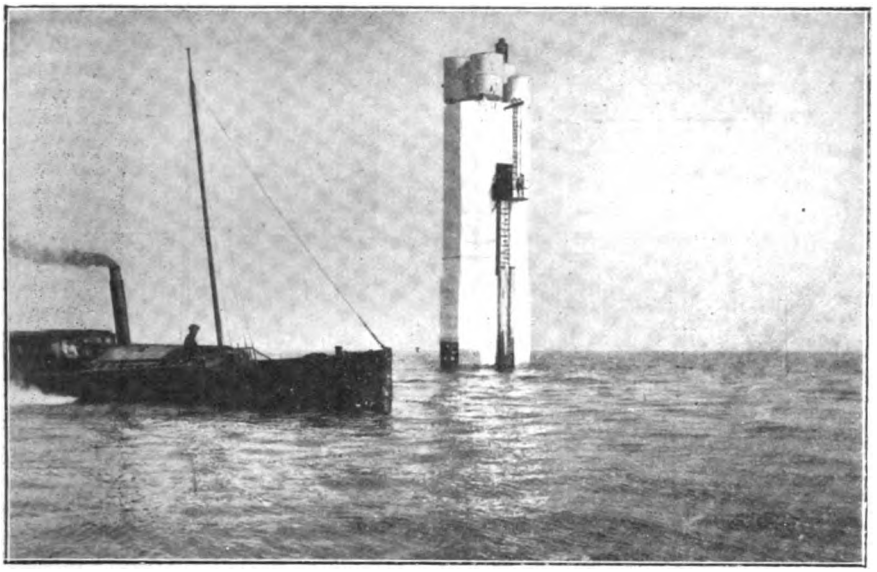
Digitized by Google

# ELECTRICAL DEVICES AT PLATTE FOUGÈRE LIGHTHOUSE.

By EDWIN O. CATFORD.

(*Copyright in the United States of America.*)

A LITTLE over three years ago the writer was placed in charge of a lighthouse, which, being the first and only one of its kind, presented plenty of scope for study. Various problems presented themselves, which, owing to the unique character of this lighthouse,



I.—PLATTE FOUGÈRE LIGHTHOUSE. VIEW FROM LANDWARD SIDE, PILOT'S LAUNCH PASSING.

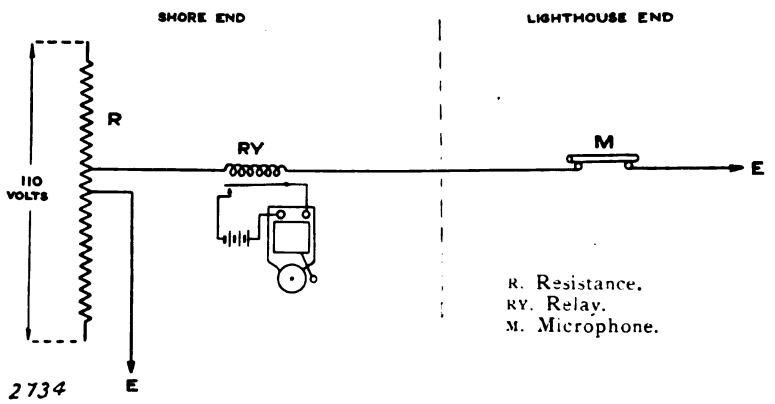
could not be solved by reference to past experience elsewhere. How the writer met these difficulties may be of interest. In every case simplicity and reliability were essential in order that the apparatus might be handled and understood by technically untrained attendants.

The lighthouse is a concrete tower built on Platte Fougère rock, nearly a mile and a quarter from the N.E. of Guernsey, a coast strewn with rocks, and very dangerous to navigation. During fog, power is transmitted from the engine-room ashore to an electric motor on the lighthouse. Air is then compressed into three tanks on the summit of the tower, and a clock, wound by compressed air, allows a blast to pass every ninety seconds through a siren and horn. This fog signal has been heard at a distance of more than 30 miles.



Digitized by Google

Two lightkeepers reside ashore, where the generating plant is established, and on the approach of fog have to start a 25 h.p. oil engine directly coupled to a 11½ k.w. three-phase generating set, which transmits about 15 amps. at 600 volts through the submarine cable. The cable is probably the heaviest armoured rock type yet made with G.P. insulation. It contains three power cores of 19/17 copper and two wires of 7/23 copper. The latter were provided in order to work a drop switch on the lighthouse, by which, in the event of the breakdown of one motor, a spare motor coupled to a second air compressor could be at once started in its place. How these two wires have been put to many other uses in addition to the single one for which they were provided is here narrated.




2.—Fog Signal Tell-Tale.

## Fog Signal Tell-Tale.

The man in charge of the engines ashore is responsible for the correct working of machinery more than a mile distant, and it is of the first importance that he should have some means of knowing that the fog signal is performing its duty. The horn being directed away from shore towards the N.E., the men in charge are behind, in the very worst position for hearing it. Moreover, the atmosphere conveys sound in a most capricious way, so that a fog signal, which on occasion is heard along the coast of France thirty miles distant, and is quite ordinarily heard in Alderney twenty miles away, is on many days barely audible ashore just over a mile distant. Some means had to be found by which each blast could be signalled to the engine-room. Obviously, this device must be operated by the vibration of the blast itself, and the first experiment was to construct, with the aid of arc lamp carbons, what is probably the largest microphone ever put to use. This was placed inside the lighthouse, so



Digitized by Google

that by listening ashore each blast could be heard by telephone. Listening at the telephone entailed waste of time and took a man from other duties, so that an electric lamp was substituted, which ceased to glow at every blast. Watching this lamp, however, had almost the same objections as the first method, so that the present device was finally adopted, by which a bell rings in the engine-room at every blast. The signal acts instantaneously, the actual sound of the blast reaching shore five seconds later.

This tell-tale has been an invaluable aid, and when the exact time of the blasts has been obtained from the tell-tale, it is remarkable how much easier it is to catch the sound on days when they are very feebly audible. The tell-tale is arranged to respond only to the full blast, and on one occasion the siren stuck with the ports open, so that the air escaped each time in a huge gasp instead of a blast. These gasps could be heard ashore, the day being good for hearing, but this was not enough to operate the tell-tale, which thus indicated in the engine-room that something was wrong at the lighthouse. The microphone consists of sixteen arc lamp carbons arranged four in series and four in parallel, and the current required, at about ten volts, is taken from the 110-volt exciter by means of the potentiometer method (see **2**).

### Gas Supply Tell-tale.

The light shown in the lantern is from an acetylene burner flashing every ten seconds, and is turned on at sunset and extinguished at dawn by means of a clock which requires winding every three months, a small by-pass flame remaining always alight. The acetylene gas required is supplied from two steel cylinders, each containing enough gas to last about one month, and before the cylinders in use are exhausted they have to be changed for full ones in order that no interruption of light may occur. Formerly no means existed for ascertaining how the acetylene was lasting, except by paying an inspection visit. This led to many boat trips, which, in winter particularly, had often to be undertaken in unpleasant and dangerous weather in order to prevent any risk of failure of light through shortage of gas. Many of these boat trips carried with them all the spice and excitement of adventure, and the writer well remembers one Sunday evening in particular when, the light having failed to come on, a visit was undertaken to rectify matters. Before one could leave the lighthouse again night had fallen, and as the boat could not remain close with the sea then running, a jump had to be made quickly as the boat swung up on a wave. In the darkness the writer found his feet not in the boat but in the sea, but having fortunately caught hold of the side of the boat, he was quickly hauled in.



Digitized by Google

These considerations led the writer to fit an arrangement by which an alarm is given ashore so soon as the gas pressure at the lighthouse falls below a certain amount which represents a fortnight's supply. To speak more correctly, a bell rings every hour so long as the gas supply is ample, so that any failure of battery or bell is equally indicated. When the bell ceases to ring at the hour a button is pressed, and if the bell then rings it shows that bell, battery and all shore-end connections are in good order, and the boatmen are notified that a visit must be paid to the lighthouse on the first fine day. Emergency visits in bad weather or late in the day have been largely eliminated, and a practical illustration of the utility of the device may be given by mentioning that the first year's boating charges amounted to £33. In July of the second year this device was fitted, and for that year the boatage charges were reduced to £18, while for the third, being the first complete year under the new conditions, the charges have amounted to £9 only.

## Electric Light.

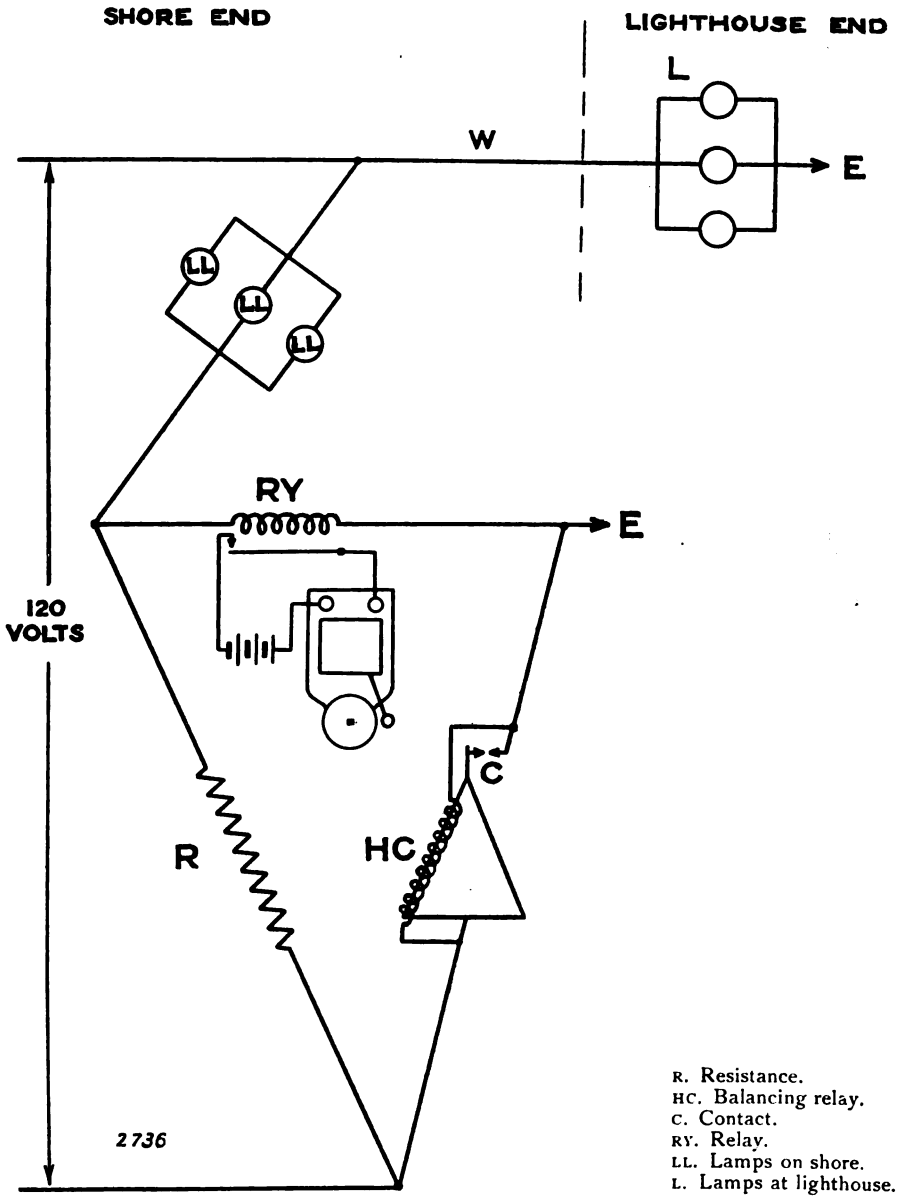
The light may fail from other causes than shortage of gas. More than once the by-pass flame has become extinguished from some unknown cause, and when this has happened during rough weather, several days have elapsed before it was possible to reach the lighthouse to relight the gas. For this reason electric lamps have now been fitted in the lantern at Platte Fougère, so that in the event of failure of the acetylene light it is possible to work an electric light in its place. The flasher in use is of the thermic type commonly used in connection with shop signs, in which the passage of current causes a contact arm to alternately expand and contract, thus closing and opening the circuit for the light. This flasher cannot be adjusted to work at a regular speed, and were the electric light in constant use or were there any other lights in the neighbourhood for which the lighthouse might be mistaken, a rotary switch driven by a small electric motor or by clockwork would need to be used to ensure exact timing of the flashes. For occasional use the present arrangement serves very well and several captains have expressed a preference for the electric light. Since the acetylene burner occupies the focal position in the lantern the electric light is at a disadvantage, and therefore three electric lamps, each of about the same candle-power as the single acetylene burner, are provided. The net result seems to be that in clear weather, at any rate, the electric light can be picked up at a much greater distance than the acetylene light.

It being essential that the man in charge shall know what is happening at the lighthouse it is arranged that every time



Digitized by Google

the electric light flashes in the lantern of the lighthouse an electric bell rings in the engine-room. Experience has shown




R. Resistance.
HC. Balancing relay.
C. Contact.
RY. Relay.
LL. Lamps on shore.
L. Lamps at lighthouse.

3.—Electric Light Check.

that an audible signal is far preferable to a visible one, and it must be mentioned that the man in charge of the engine cannot readily watch the actual light from the lighthouse because



Digitized by Google

the principal windows of the engine-room face S.E. and S.W. respectively, while the lighthouse lies to the N.E. Electric lamps as now made are fairly robust, but the fog-signal when working causes very great vibration, and therefore it has been arranged that in the event of the filament of a lamp breaking while the electric light is in use, the signal-bell will announce the accident by ringing continuously instead of only at each flash. This is accomplished by means of a Wheatstone bridge arrangement, three lamps ashore balancing the three at the lighthouse. Should the bell ring continuously it can at once be proved whether this is caused by the failure of a lamp at the lighthouse by taking out a lamp ashore. If the bell then stops it shows conclusively that two lamps only remain at the lighthouse. Thus the lamps, although over a mile distant, are nearly as completely under observation as if they were at hand ashore. One Tantalum and two Osram lamps for 105 volts are in use, about 15 volts being lost in the cable (see 3).

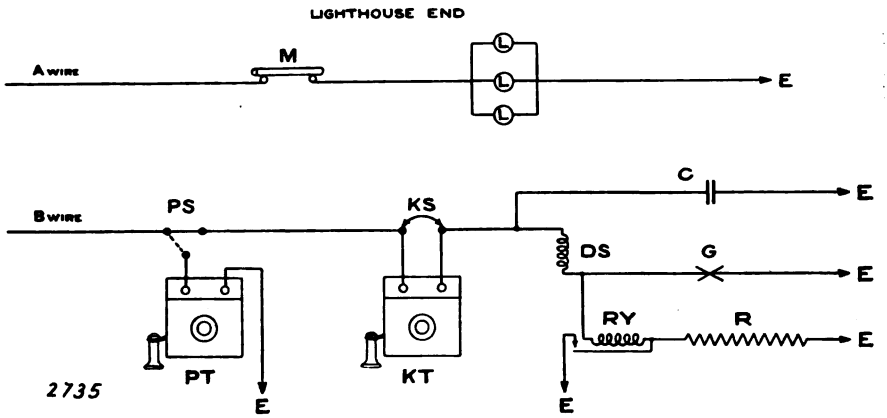
### An Ocean Telephone Call Office.

It was very soon found that during visits to the lighthouse a telephone for the use of the keepers was indispensable. This instrument is in one of the chambers of the lighthouse and can only be reached by the keepers themselves. Lately it occurred to the writer that a telephone outside the lighthouse accessible to all who care to climb the ladder might prove of value, and thanks to the kind permission of the supervisor, Mr. Julius Bishop, this has now been fitted. The primary object of the new telephone is to obtain news of the approach of mail boats during fog, when, guided by the sound of the fog signal, they frequently creep up to within two ships' lengths of the lighthouse before dropping anchor. In future, any pilot knowing of the presence of a mail boat may at once telephone this news to the Central Telephone Exchange of Guernsey, where it will be placed at the service of any subscribers making inquiry throughout the island. It is hoped that pilots will make themselves familiar with the telephone, so that when any sudden emergency calls for its urgent aid there will be no doubt or uncertainty as to its use. The act of opening the door disconnects various tell-tale and other lighthouse devices from the cable, leaving the pilots' telephone in their place. By ringing up in the usual way, the lightkeepers ashore, one of whom is always on duty day and night, can be called, and thence the telephone is plugged through to the Exchange. On leaving the telephone it is essential that the lighthouse door shall be properly closed, and to safeguard against forgetfulness it is arranged that the pilot using the telephone cannot lift the trap-door to reach the ladder until the door is first entirely closed. Only one wire in the submarine cable is available for the telephone, so that an



Digitized by Google

"earth return" is used, with a transformer ashore to connect with the Guernsey system. Speaking is good even when 18 electrical horse-power is passing through the power-cores of the same cable to work the fog signal. The instrument in use is of the usual type in a walnut-wood case, all coils, etc., being well paraffined, this being preferred to the watertight "mining" telephone with iron case, which seems to invite leakage and condensation troubles. For the present the keepers' telephone inside the lighthouse is being retained, since the pilots' telephone is in a somewhat exposed position and is more likely to get out of order; should that happen, the second telephone will prove an invaluable aid (see 4).




4.—An Ocean Telephone Call Office.

PT. Pilot's telephone. PS. Pilot's switch. KT. Keeper's telephone. KS. Keeper's switch. DS. Drop switch.

## Automatic Fog Alarm.

The writer has devised an automatic fog alarm, which so far remains on paper only. This consisted of a selenium cell fitted on the lighthouse at 15 ft. distance from the lantern. So long as the light flashed on the cell every ten seconds an alarm bell ashore would be prevented from ringing. When fog obscured the light, or when it failed from other causes, the alarm would be given ashore.

## Induction.

The Guernsey-Alderney and Guernsey-England telegraph cables lie parallel with the lighthouse cable at not many yards' distance from it, and at one time Post Office engineers feared that some inductive disturbance might result in the telegraph cables when the fog signal was at work. Careful tests, however, showed these fears to be groundless, and the fact that speech is possible from the light-



Digitized by Google

house, using an earth return, is additional proof of the absence of inductive effect.

### Wireless Telephone: Guernsey to Herm.

Another project which the writer regrets has not come to fruition is the linking up of the small island of Herm with Guernsey by means of a wireless installation on the Skerries model. Herm, with less than two score inhabitants, obviously could not contemplate an expensive system with complicated machinery, and the simplicity and cheapness of the proposed experiment seemed greatly in its favour. Moreover, Guernsey with its network of telephone lines seemed to offer exceptional facilities for experimenting with a number of different base lines earthed at various points all round the island. The chief interest of the proposal, however, lay in the fact that the cable to Platte Fougère, nearly 1¼ miles long, was by kind permission of the Supervisor permitted to be used, and since the addition and subtraction of the cable from the base line would scarcely alter the inductive effect, while it would considerably affect the distance of sea conduction, it was hoped something more might be learned of the relative parts played by conduction and induction in this method of telephony. The writer still has some hope that something may result from this proposal, although the time has not yet come for it.

### General Remarks.

The wire used for connecting the various devices described is 3/20, which for mechanical and other reasons seems the smallest desirable. Eight hundred megohm insulation is used, and in the writer's opinion this is quite as reliable and lasts fully as well as more highly priced grades of insulation. Makers often provide fittings with the smallest possible terminals, leading to the objectionable practice of inserting one strand of wire in the terminal and cutting the other strands short. To ensure terminals of ample size the writer finds it advisable to use no cut-out or switch rated under 10 amps., even where less than one ampère is involved.

To guard against failure of apparatus depending on a battery it seems wise to provide fully double the number of cells that would at first seem necessary.

To guard against electrolytic troubles double pole contacts are used, so that no possible battery leakage can take place through the cable when apparatus is not working. With the electric light and other apparatus worked from the exciting current it is arranged that polarity is reversed every time a change is made from one generating set to the other.

The neutral point of the three-phase power circuit is not earthed.



Digitized by Google

For resistances the writer uses carbon filament lamps, whenever possible, owing to their convenience and absolute safety, always using at least two in parallel, so that no device depends on a single filament. So far as possible all batteries, resistances, fuses, etc., are placed at the shore end of the cable, where they can be under constant observation, all apparatus remaining at the lighthouse being reduced to the simplest form. For the protection of the engine-room the writer depends more upon entirely concealed door contacts than upon bolts and bars. Visitors sometimes think they will have a look round the engine-room without troubling anyone, and are surprised to find that directly they have opened the door an attendant appears on the scene.

When Baby Catford was four months old he used to be put to sleep out on the common, with a telephone instead of a nursemaid to let his mother know when she was wanted. So long as the boy's mother could hear the ticking of a clock that lay beside the boy but could not hear him crying she knew all was well, and no failure of the telephone could occur without being known.

Another matter of domestic interest might be referred to. The writer possesses two cats, and because they catch fish as other cats catch mice, visitors sometimes come the five miles from town purposely to see them. They have their own electric bell, which they habitually ring to gain admittance to the house, a little shelf on which they stand making the necessary contact.

## STRUCK BY LIGHTNING.

It does not frequently happen, I suppose, that a domestic incident forms the subject of a communication to this JOURNAL. The occurrence I have to relate, however, is by no means an everyday one, and as it concerns an experiment in high potential electricity —albeit an involuntary one—it may, perhaps, be found of interest to some few of my colleagues. As a matter of fact it is at the express request of a prominent member of the Institution that I am sending this account for publication.

About a quarter to two a.m. on May 30th, during a violent thunderstorm, I was unfortunate enough to have my residence struck by lightning. The house is situate in a high and very exposed position, and the rain driving tempestuously into the children's room (seen to the right of the photo) caused me to hasten thither, in response to their cries, to close the windward window. Whilst so engaged I remarked the extreme rapidity with which the thunder followed the flashes, and realised that I was at no great



Digitized by Google

distance from the centre of the disturbance. Instead of lingering to watch the display as is my wont, I felt a distinct relief upon retiring from the window after mopping up the worst of the water from a dressing-table which stood there.

I proceeded to the bath-room and was standing within a few inches of the bath when the crash came. It was an appalling, nerve-shattering experience. I cannot easily describe the sound of that discharge, but the noise was, of course, deafening. It was a titanic, reverberating *bang* with a metallic ring at the end of it, and not for a moment to be confounded with even the loudest thunder-clap. It goes without saying, perhaps, that I knew on the instant what had happened, and my first sensation was one of surprise at finding myself still alive and the house standing. But this was no time for speculation. I dashed to the back room, where, by the grace of Providence, I found all safe, though naturally the youngsters were in a state of terror. Having brought them into the front bed-room and calmed them somewhat, I descended to the lower regions to ascertain the damage and to search for fire, which the strong smell of sulphur which pervaded the house seemed to suggest.

On opening the kitchen door a scene of desolation met my gaze. No fire, but the whole floor was strewn with wreckage, and it took some little time to make out, in the dim light, precisely what had happened there. The mantelpiece lay before me upon a pile of *débris*, and all around were fragments of the stove, tiles, rubble, soot and miscellaneous articles. Strange to say the clock on the wall above the fireplace was still ticking merrily, though a later examination showed that two of the pins clamping the movement to the case had been shaken out.

Finding no further internal damage I reascended and observed the rain coming through the ceilings of the two back rooms, showing that the main roof had been holed, and I could also make out that masses of brickwork had fallen on and through the roof of the rear extension and had also cleared the whole of the glass from a 10 ft. by 10 ft. verandah (1).

As the rain soon ceased there was nothing to do but to wait for daylight.

Subsequent investigation showed that the point which was first struck was a galvanised iron elbow extension surmounting the rear chimney-stack, and this was confirmed by a neighbour who happened to be looking in the direction of my house at the moment, and who described the phenomenon as a ball of light, about a yard in diameter, which appeared to rest for a second or two on the chimney and then to explode and disappear. The charge, no doubt, found a more or less easy path through the probably damp soot of the chimney, but on reaching the kitchen grate—which I should state was of sitting-



Digitized by Google

room pattern—it apparently had to make contact with the boiler behind in order to get to earth *viâ* the hot and cold water systems, and in so doing was forced to spark across the gap: hence the disruptive effect upon the fireplace. As the boiler is inaccessible without removing the surrounding fire-clay I have been unable to make a thorough examination of it, but the probability is that the soot and scale would obliterate any physical evidence of the passage of a

I.—View of the Back of the House after Flash.

current. Incidentally, it would be interesting to know what would have been the effect had I been *touching* the enamelled iron bath at the critical moment, and also whether there is any connection between this assumed path of the current and the fact that to me—judging from the location of the sound of the discharge—it was apparently the bath itself which had been struck whereas the actual points of contact were in a totally different direction.

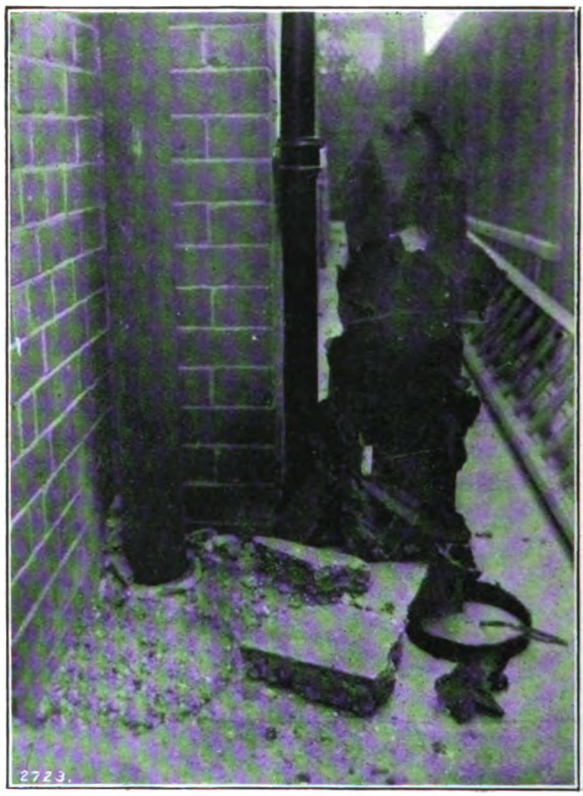
It is somewhat remarkable and certainly most fortunate that no portion of the charge worth considering passed down the other chimney of the stack—that of the children's room. The only effect



Digitized by Google

on the grate of that room was a slight loosening. There would be a certain amount of soot in this chimney, but the absence of a boiler no doubt made all the difference.

The whole of the charge did not, however, pass down the chimneys, and this appears to me to be a point of interest. Amongst the material lying by the side of the house I observed, near the base of an iron ventilating shaft, two slabs of cement work, measuring together




2.—Damaged Concrete at Base of Ventilating Shaft.

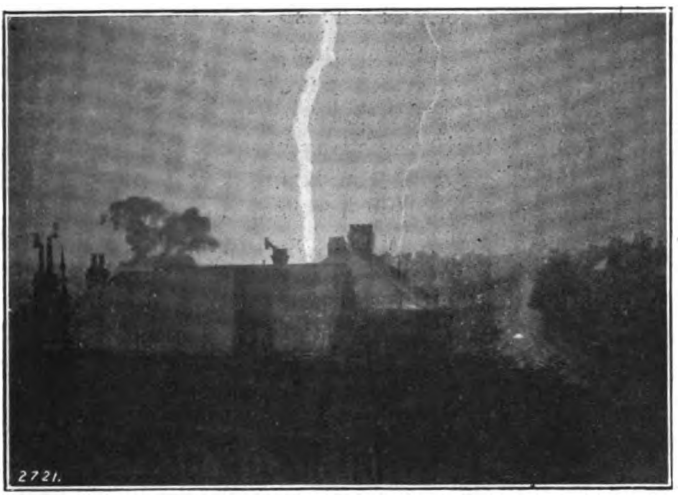
about a square foot by 3 in. thick, which had been lifted up and deposited close by. The galvanised wire cap at the top of the pipe was thrown down, and though this shows no mark of violence, it would appear that the current divided, and possibly the major portion leapt across and down from the chimney top to the cap of the shaft. There is no other way in which to account for the displacement of the cement, and, in fact, this is precisely what might be expected to occur, as the shaft terminated just beneath the cement in an earthenware duct, hence the easiest path to earth would lie under the concrete. The socket of the duct was broken away, and the slabs



Digitized by Google

and also the particles of cement left behind bear distinct traces of the passage of the current, the heat generated having calcined the surfaces and caused the formation of little glassy nodules. No doubt the resistance presented by the duct socket and the fact that the earth beneath the concrete was in a dry state explains the bursting up of the slabs (2).

The chimney-stack was 12 ft. high, and was solidly built of the heaviest bricks I have seen used in dwelling-house construction. Masses of brickwork were flung in all directions, some pieces being 60 ft. distant, and only about 6 ft. of the outer wall of the stack remained. The lead flashing at its base was melted in places, and the "elbow" at the top was torn to shreds, bits of it being found




3.—The Cause of the Damage.

scattered in various parts of both front and back gardens. The larger pieces I have included in the photo showing the base of the ventilating shaft, but I fear they will not show up very clearly in the reproduction. The damage done also included nearly 1000 tiles broken besides gutterings and snowguard carried away, not to mention the wholesale destruction of garden stock. It may be of interest to state, however, that the fire insurance companies concerned accepted liability both in regard to the fabric and the contents of the house, although no actual fire occurred.

I am glad to be able to give a photograph of the identical flash of lightning that caused this havoc. It was sent to me by a local chemist who was exposing some plates half a mile away, and a comparison of times and the topographical evidence of the photo itself remove all doubt on this point (3).



Digitized by Google

In conclusion, lest some should incline to commiserate with me, let me say that, on the contrary, I should be congratulated on the whole upon my good fortune, for both builder and surveyor have assured me that had the stack fallen *en masse* on the roof it would inevitably have crashed through on to the bed where not only lay my two children, but where also my wife was sitting at the time endeavouring to reassure them, and, had this happened, not one of them, except by a miracle, could have survived.

B. F. GILLETT (Croydon).

## BOOK REVIEW.

'Graphs in a Cable-ship Drum Room,' by E. Raymond-Barker. Published by H. Alabaster, Gatehouse & Co. Price 2*s.* 6*d.* net.

This little brochure is a reprint of a series of articles published in the 'Electrical Review,' January 17th, 1913, *et seq.*, and is intended as an aid to young fellows on first joining the staff of a cable-ship. It deals in a simple way with the principal calculations necessary in connection with the laying of cables—calculations of the cable drum constants, length of cable paid out or picked up, rate of paying out or picking up, amount of cable slack, and the taut wire measuring gear.

Graphical methods of making these calculations, together with a transparent disc calculator for obtaining cable slack or other percentages, designed by the author, are described clearly.

There is one novel point in connection with these graphs which will probably be found to have a wide field of usefulness. Every fifth vertical and horizontal line on the squared paper is continuous, while the intervening lines are printed in *dots* and *dashes* corresponding to the figures 1 to 4 in the Morse code. The curves also, representing, say, various percentages from 1 to 20, are marked in *dots* and *dashes* corresponding to the Morse code figures. This method of construction, especially on large sheets of squared paper, will considerably facilitate working, as the position of any point on the curves can be easily read from the Morse code figures without the irksome necessity of following a line throughout its length to refer to the figure in the margin. A. G. L.

LONDON-PARIS ELECTROPHONE.—Successful experiments were recently made over the new loaded Anglo-French trunks in the transmission of music from the Paris Grand Opera to London and from Covent Garden to Paris. After some preliminary difficulties had been overcome very successful hearings in both directions were provided.



Digitized by Google

# HEADQUARTERS NOTES.

## POST OFFICE (LONDON) RAILWAY: INTERESTING ENGINEERING PROJECT.

Post Office enterprise, particularly on the Engineering side, has come somewhat prominently before the public notice recently, and the proposal to construct a postal tube railway in London has attracted a great deal of attention.

The object of this railway is to enable the Post Office to accelerate the transmission of mails and parcels, to reduce its expenditure on road vans, and to relieve to some extent the congestion of traffic in the streets of the Metropolis. The scheme is, therefore, one of considerable public importance.

The railway, which will be worked and controlled by electricity, will extend from Paddington to the Eastern District Office in Whitechapel, a distance of just over six miles. Access will be given from the Great Western Railway Station to the Paddington District Office, and there will be intermediate stations at the Western District Parcels Office, the Western District Post Office, the West Central District Post Office, the Mount Pleasant Sorting Office, the General Post Office (King Edward's Building) and the Great Eastern Station at Liverpool Street. The depth of the tube will vary between 28 and 87 ft. below the surface of the ground, and it will take a course through the London clay at a minimum depth of 10 ft. below the top of the clay. The tunnel—which will be lined with the usual cast-iron segments—will be 9 ft. in diameter and will have two tracks of 2 ft. gauge, one for the "up" line and one for the "down" line, with a clear walking space between the tracks of 1 ft. 6 in. At the stations, separate tunnels, having an enlarged diameter up to a maximum of 25 ft., will be provided for the "up" and "down" lines; they will be on the same level and have a distance between them of about 20 ft. with passages to provide accommodation for lifts, elevators, shutes, and control cabins. Access will be provided by means of passages from one tunnel to the other to connect the two platforms, which will be constructed on the inside of each tunnel, thus forming a combined island platform. At certain stations provision will be made for subsequent extensions in northerly and southerly directions.

The trucks, which will be made of steel, will be capable of taking the largest receptacle at present in use in the Post Office. These receptacles will be transferred from the several post offices to the subjacent stations by means of spiral shutes or elevators, whence they will be transferred in trolleys to the trains. The mail receptacles,



Digitized by Google

on arrival at the stations, will either be trolleyed to the base of an elevator or lift, or, at the more important stations, will be dropped through openings in the station platform on to a continuously moving band conveyor, which will transfer the mail receptacles to the elevator, where they will be automatically picked up and raised to the sorting office level.

Between the stations the maximum speed of the trains will be thirty-five miles an hour, but when running through stations, the speed will be reduced automatically to about twelve miles an hour. Trains intended to stop at a station will be automatically reduced when nearing the station to a speed of six miles an hour. Changes in speed will be brought about by variations in the pressure of the current provided for driving purposes. The section of the track adjacent to a platform at which it is intended a train shall stop will be made "dead," and the train brought to rest by an electric brake automatically applied.

The trains will be controlled by men located in the control cabins at the several stations (referred to above). No drivers will be employed on the trains themselves; that is to say, the trains will be worked on the "distant control" principle. As was pointed out to the Select Parliamentary Committees by Mr. Slingo, the distant control method itself is not novel—every application of electricity is an illustration of it—but this will be the first instance of a railway designed solely for the transmission of mail matter on a commercial scale and utilising trucks without drivers.

The capital cost of the scheme is estimated at £964,000.

The scheme has been prepared by the Engineering Department, but Mr. H. H. Dalrymple-Hay, who holds the premier position in London as consulting engineer for tube railways, has been called in to assist the Engineer-in-Chief in the design and construction of the Tube, so that this portion of the scheme, which falls outside the usual scope of the work of the Engineering Department, is in good hands. The equipment has also been carefully thought out, but as this portion of the scheme will be put out to tender on somewhat open lines, it is probable that many of the details will be subject to variation. Concurrently with the equipment of the railway the present generating station at Mount Pleasant will be dismantled.

### Exchange Equipments.

An order has been placed for the equipment of a new C.B. Exchange at Purley for 1200 lines.

Orders have been placed for extending the existing equipments at Edinburgh, Langside, Lee Green, Lincoln.

Installation of C.B. equipment has been commenced since the last issue of the Journal at—



Digitized by Google

| | |
|---|---|
| Barnsley (New Exchange) . | . 480 lines. |
| Kilmarnock ,, . | . 440 ,, |
| Llanelly ,, . | . 400 ,, |
| Museum ,, . | . 9720 ,, |
| War Office (New P.B. Exchange) | . 500 ,, |
| Avenue (Extension) . | . 420 ,, |
| Doncaster ,, . . | . 280 ,, |
| Ibrox ,, . . | . 120 ,, |
| Kingston ,, . . | . 540 ,, |

## Insulated Wire for Crossing Unguarded Power Circuits.

A covered bronze wire for the above purpose has been added to the list of standard articles. The conductor is about 60 mils in diameter, weighs 55 lbs. per mile and has a resistance of 28·6 ohms. at 60° F. It is insulated with a double layer of specially prepared paper and a lapping of cotton, the whole being braided with jute yarn impregnated with a weather-proof composition. The weight of the completed wire is about 134 lbs. per mile; say 5 lbs. to a 65 yards span.

At each end of the span which crosses the power circuit the insulated wire is terminated in the following manner: A covered binder is first passed round the the lower groove and twisted for one or two turns close to the insulator, leaving the two ends to form a double binder; then the end of the covered bronze wire is taken once round the lower groove and laid beside the main wire for a distance of 7 in. from the centre of the insulator. The double binder is then tightly and closely wrapped round the two for a distance of 2½ in., after which the end of the bronze wire is turned sharply back and wrapped three times round the termination; finally the wrapping of the binder is continued along the main wire for a distance of 1 in.

The covering of the bronze wire is removed for a distance of 1½ in. for jointing to the tail piece of the bare line wire of the adjoining span, which is terminated on the upper groove. The connection between the tail pieces is made by means of a nib joint, *i.e.* the ends of the two wires are inserted into the same end of a copper jointing sleeve and the whole given two complete turns to ensure good electrical and mechanical connection.

## Rupinised Wood Poles.

The Ruping process of creosoting having been adopted by the Post Office it is thought that a few words on the subject may be of interest.

The theory of this process is that it gives as good penetration of



Digitized by Google

creosote oil and as great duration of life as was obtained by the methods formerly in use, although only half the quantity of oil is required. These results are obtained by first forcing air into the timber and thereafter forcing in oil. When the pressure is taken off the expanding cushion of air forces the unabsorbed oil out of the sapwood, leaving as a preservative only so much as saturates the walls of the cells.

Briefly, the details of the process may be described as follows: The timber, properly seasoned and dressed, is enclosed in a cylindrical iron tank, and air is pumped in until a pressure of 50 to 55 lbs. per square inch is obtained.

Creosote is then run in and the pressure gradually raised to 135 or 140 lbs., the temperature maintained being about 130° to 140° F. When the pressure is taken off the surplus oil is driven back into the storage tank.

After the poles are taken out they rapidly become dry on the surface, and they are consequently much less objectionable to handle than poles creosoted by the ordinary process.

It is contended that owing to there being little or no free creosote oil in the timber the surrounding soil does not become saturated with it by exudation after the poles are erected.

But perhaps the principal advantage claimed for this process is economy, the amount of creosote oil retained by the timber being, as stated above, only about one half of that retained with the ordinary method, viz. 5 to 6 lbs. per cubic foot as against 10 to 12 lbs. As the price of creosote has considerably increased of late years this is an important consideration.

## COUNCIL NOTES.

MEMBERS of the Council of the Institution of Post Office Electrical Engineers, for the year 1913–14:

W. Noble, Esq., Chairman.

| | |
|---|---|
| Mr. J. Sinnott<br>Mr. W. Cruickshank | Engineer-in-Chief's Office. |
| Mr. J. Brown | Exec. Engineers, London. |
| Mr. F. McMorrough | ,, ,, Provinces. |
| Mr. H. E. A. Wenman | Assist. Engineers, London. |
| Mr. T. Patterson | ,, ,, Provinces. |
| Mr. T. Barradell | Sub.-Engrs. and C.I., London. |
| Mr. H. Cranage | ,, ,, Provinces. |
| Mr. W. T. Harris | Clerical Staff, London. |



Digitized by Google

| | |
|---|---|
| Mr. P. A. Corney<br>Mr. T. McMullen | Clerical Staff, Provinces. |
| Mr. J. W. Atkinson | Treasurer. |
| Mr. T. Smerdon | Secretary. |

A meeting of the newly elected Council for the Session 1913–14 was held at the Institution of Electrical Engineers, Victoria Embankment, W.C., on June 10th last. Mr. W. Noble presided and offered a cordial welcome to the new members: Messrs. J. Brown, W. Cruickshank, H. Cranage and W. T. Harris.

It was reported to the Council that Treasury authority for free travelling of Senior Inspectors and Inspectors as Associates of the Institution had been obtained, and it was decided to recommend to the members the amendment of the rules to admit Inspectors in addition to the Senior Inspectors and Probationary Sub-Engineers, which had already been approved.

## "President's Award" Competition.

Three papers were submitted for adjudication, two on an engineering subject and one on a clerical matter. The adjudicators awarded the prize of three guineas for an essay on an engineering subject to Mr. A. B. Eason, Assistant Engineer, Engineer-in-Chief's Office (*nom-de-plume*, "Strax"), for his paper entitled "Pneumatics." They decided that the only essay on a non-engineering subject was not worthy of a prize.

A communication from the London Centre *re* proposed alteration of the Constitution of the Institution was considered by the Council.

The proposals were suggested with a view to bringing the constitution of the Institution more into line with that of other scientific bodies and to place the representation on a more satisfactory basis, and involved the following alterations:

(1) The control of London business to be by the Council with the consequent disappearance of the Metropolitan Committee and the formation of a local centre at the headquarters of each Provincial District with the exception of the South-Eastern District, which would be attached to London.

(2) The appointment of salaried officers to be made by the Council from members of the Institution.

(3) Proportional representation of members, including Superintending Engineers, Staff Engineers, Assistant Superintending Engineers and Assistant Staff Engineers.

(4) The members of Council to hold office for three years—one third retiring annually.

The proposals were fully discussed and the following resolution



Digitized by Google

proposed and carried: "That, after full consideration, the Council are of opinion that it is inadvisable to adopt the suggestion of the London Committee for altering the constitution of the Council."

The following appointments were made by the Council for the Session 1913—1914:

*Board of Editors.*

| | |
|---|---|
| Chairman . | Mr. J. Sinnott. |
| Members . | Messrs. J. W. Atkinson and W. T. Harris. |
| Managing Editor | Mr. W. Cruickshank (from August 1st, 1913). |

*Library Committee.*

| | |
|---|---|
| Chairman . | Mr. J. W. Atkinson. |
| Members . | Messrs. J. Brown, H. E. Wenman, W. T. Harris, T. Smerdon. |

*Librarian.*

Mr. J. Smerdon.

*Editing Committee.*

(Four Members) (Chairman of Council and Secretary *ex-officio*).
Messrs. T. Purves, A. W. Martin, J. W. Atkinson, J. Brown.

### Winter Programmes.

The Secretary was instructed to press the Local Secretaries to supply details of their Winter Programmes in order that the display cards might be issued prior to the commencement of the session.

The next meeting of the Council will be held in London on October 7th.

### Subscriptions.

Members are reminded that subscriptions are now due, and their attention is directed to Rules 5 and 8 in connection with this matter. It is desired to complete the collection of subscriptions by October 31st, and perhaps members will be good enough to remit through their local secretaries before that date.

### Associates.

The amending of the Rules to admit Probationary Sub-Engineers, Senior Inspectors and Inspectors as Associates of the Institution has now been approved by the members, and local secretaries are asked to forward a copy of the special circular which has been issued to each of the eligible officers in their district. It is hoped that all will avail themselves of the opportunity of joining the Institution as associates.

T. Smerdon (*Secretary*).



Digitized by Google

# LOCAL CENTRE NOTES.

## LONDON CENTRE.

DURING the recess the Committee have been engaged in the preparation of the programme for the forthcoming Winter Session.

The meetings will be held as usual in the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, W.C., at 6 p.m., the opening date being Monday, October 13th. Mr. A. B. Eason will read a paper on "Telegraphic Traffic and Power Plant for Pneumatic Tubes in Post Offices."

A successful visit took place to Messrs. Siemens' Works on Wednesday, August 27th. A party of forty members took part, and they met with a very cordial reception from the firm. Mr. H. C. Price, a member of the Committee, represented the Institution on this occasion.

The composition of the Committee for the year ending March 31st, 1914, is as follows :

*Nominated Members.*

| | |
|---|---|
| Chairman | Mr. A. W. Martin. |
| Vice-Chairman | Mr. J. M. Shackleton. |

*Elected Members.*

| | |
|---|---|
| Headquarters Staff | Mr. E. Lack, Mr. C. W. Burge. |
| Executive Engineers | Mr. H. C. Price, Mr. J. G. Hines. |
| Assistant Engineers | Mr. E. J. Wilby, Mr. W. Dolton. |
| London Clerical Staff | Mr. A. E. Everett, Mr. E. H. M. Slattery. |
| S.E. District Staff. | Mr. J. Cowie, Mr. F. Penfold. |

*Co-opted Members.*

| | |
|---|---|
| Local Librarians, London District | Mr. G. F. H. Henderson, Mr. C. A. Eastop. |
| Local Librarian, Metropolitan Power District | Mr. R. Smerdon. |
| Local Librarian, S.E. District. | Mr. H. Longley. |
| Honorary Secretary | Mr. W. G. Owen. |

Mr. Burge will act as the representative of the Institution at Headquarters.



Digitized by Google

# THE LONDON CHAMBER OF COMMERCE AND THE TELEPHONE SERVICE.

We are indebted to the London Chamber of Commerce, through the courtesy of Mr. Charles E. Musgrave, Secretary, for permission to reproduce the "Minutes of proceedings of a deputation which waited upon the Rt. Hon. Herbert Samuel, M.P. (Postmaster-General), on July 4th, 1913, on the subject of 'The Telephone Service.'" The minutes were issued in pamphlet form by the Chamber, and in view of the importance of the subject matter to our readers we have no hesitation in printing the report practically verbatim.

The Deputation consisted of—

The Rt. Hon. Lord Southwark (President), Mr. F. Faithful Begg (Chairman of the Council), Mr. L. A. Martin (Deputy Chairman of the Council), Mr. Arthur Serena (Treasurer), Mr. Stanley Machin (Vice-President), Mr. J. S. Daniels (Chairman of the Postal, Telegraph and Telephone Committee), Mr. J. M. Dick (Deputy Chairman of the Postal, Telegraph and Telephone Committee), Mr. S. Kutnow (Member of the Postal, Telegraph and Telephone Committee), Mr. Charles Hopton (Member of the Postal, Telegraph and Telephone Committee), Mr. Charles E. Musgrave (Secretary).

The Postmaster-General was accompanied by Captain Cecil Norton, M.P., Mr. A. M. J. Ogilvie, C.B., Mr. L. T. Horne, Mr. G. F. Preston, and Mr. C. W. Hurcomb.

The recommendations which the London Chamber of Commerce desired to put forward related to:

(*a*) The terms of the contract which telephone subscribers are obliged to sign, and which is considered inequitable from their point of view.

(*b*) The system of registering calls and the urgent necessity of adopting some contrivance whereby calls are registered at both ends of the wire.

(*c*) The provision of additional junction lines.

(*d*) The desirability of modernising the London telephone exchanges.

(*e*) The necessity of accelerating the improvements in the trunk line service.

(*f*) The need for greater efficiency of and supervision of telephone operators.

(*g*) The inconvenience of the "pillar" instrument.

(*h*) The increased cost of telephone facilities.

The deputation was introduced by Lord Southwark, who said that the members had come in a friendly spirit to discuss the service with the Postmaster-General and to assist the Department and the commercial community, because the Chamber thought it was undesirable that the Postmaster-General should have an idea that everything is going on satisfactorily. There would be only three speakers, Mr. Faithfull Begg, Mr. Machin, and Mr. Daniels.

Mr. Faithful Begg: I am glad, Mr. Samuel, that Lord Southwark has emphasised the fact that we are not here in any hostile spirit, that we are not here as captious critics in any sense at all, although we shall have to bring before you certain points which we think require attention. We are rather, as Lord Southwark has said, anxious if possible to assist the Department to bring about changes which we think are necessary, and which probably the Department itself knows are matters which should properly be brought under your attention. We might make the general criticism that the whole system requires very considerable improvement and alteration, but I will not occupy your time with any general consideration of that kind—we shall probably agree to a large extent in that—but rather bring forward specific points to which we think attention might be directed. I will try to be as brief as possible, because we know your time is very valuable.

The first question which I am asked to mention to you is the subject of the registration of calls, to which I shall refer more fully in a minute, but in connection with that there is one point I wish to make now, and it is a very serious and very important point, namely, what we think is the inequitable character of the contract which a subscriber is called upon to enter into. I have a copy of the contract here, and the particular part of it to which we take serious exception is in Clause 15, where it says: "The expression 'certified'



Digitized by Google

means certified under the hand of an appropriate officer of the Post Office, and any such certificate shall be conclusive evidence of the matters certified." Well, in connection with that I need only quote the dictum of a judge, Judge Lumley Smith, who said that a subscriber by signing this agreement places himself entirely in the hands of the Post Office. Well, we submit that is not fair in a business matter of this kind that a subscriber should in that way be practically barred from any legal remedy. For one reason alone I think that is so, because we all know the sentimental effect of irritation in a man's mind if he is suffering, or thinks he is suffering, under an injustice, and moreover from another point of view it appears to me of great importance, because it must inevitably relieve officials from that proper sense of responsibility which would be upon them if they knew the subscriber was not in that practically helpless position. In connection with that, it may be referred to, I think, that the Post Office itself from time to time has to admit that allowances have to be made to subscribers, and that unaccountable inaccuracies do occur in connection with the registration of calls and the service generally. That, as I say, is a very important point, and we strongly urge that it should be seriously considered, and that some concession should be made; that the Department should not attempt to hold itself in any sense above the law. We quite recognise that it would have to be done in a very cautious manner, but that the subscriber should not be put in the position to which I have referred is undoubted.

The POSTMASTER-GENERAL: What alternative would your Committee suggest? We deal now with about a million calls a day in London, and by what method would you have the accounts assessed? Would you leave it for evidence for the subscriber to state on oath that he had not made certain calls, and the Department to place its records before the Court? Obviously the operators cannot remember whether the calls have been made or not during a certain period.

Mr. FAITHFULL BEGG: I am not authorised to make any definite suggestion, but I think the suggestion there is that if some method of registration at both ends could be arranged it would meet the difficulty. We have it in evidence from one of our members that for years he has endeavoured to keep a proper record of his calls, and that he has never succeeded in getting within reasonable reach of the amounts that the Department has called upon him to pay.

The POSTMASTER-GENERAL: If there were a subscriber's meter as well as a meter at the Exchange that would be accepted as sufficient evidence? You do not suggest that that clause in the contract should be simply deleted, and that there should be the possibility of litigation over every account?

Mr. FAITHFULL BEGG: Of course the matter is exceedingly difficult, and I am not authorised to make any definite or specific suggestion. I was rather asked to direct my remarks to the fact that it was inequitable that there should be no remedy as at present, and the clause in the agreement which I have read practically puts the subscriber in that position; but I will leave that point to Mr. Daniels if he will kindly take it up. Of course the inaccuracies are numerous, but possibly not excessive. I understand that in the London Telephone Service it is claimed that for every 100 accounts sent out something like 12 per cent. are disputed. We may differ whether 12 per cent. is an excessive amount or otherwise, but on that I might say the chances are that many people do not dispute their account who otherwise would, because busy men say, "Oh, well, pay it and let it go." But the official figure given to us is, I understand, the number of disputed accounts.

The POSTMASTER-GENERAL: Not disputed, but with regard to which inquiries are made.

Mr. FAITHFULL BEGG: It is given to me as disputed.

The POSTMASTER-GENERAL: I am informed that these are inquiries which after the first explanation drop to 2 per cent., and that only 2 per cent. are disputed after the information which is asked for has been given. Twelve per cent., of course, would be a very large figure if it were the case that 12 per cent. of the accounts were really traversed by the subscribers.

Mr. FAITHFULL BEGG: I will not further argue the point. Of course we admit that



Digitized by Google

any proposal to return to a flat rate is impracticable. We do not sympathise—the London Chamber never has—with the idea that the flat rate can be perpetuated. The flat rate was an empirical device for the purpose of getting at a basis of charge, and in the early stages it worked fairly well, but to-day and in recent years it is not a system which can be logically advocated. Therefore we do not suggest that any return to a flat rate would be a matter which we at all events would support in any sense.

The next point I am asked to refer to is one which is a constant source of irritation, and that is where the reply "engaged" is given. I am afraid some of these points are rather trite but I have to go through them. The Chamber thinks that the information they have points to that being caused largely by the insufficiency in the number of junction wires, and that by increasing the number of junction wires a remedy in a large measure for that would be found and should be found. Of course it is very difficult for the operator to give a correct explanation always, but we do not think, for instance, that the reply "engaged" should ever be given if it is a junction wire which is not available or if they are overcrowded at the time, because that causes misunderstanding. Inquiries are made by the man who does not get his connection and he finds that the man at the other end was not using his telephone, and that reacts on the credibility of the official. We therefore suggest that care should be taken that that reply is not given unless it is the subscriber who is wanted that is engaged.

The next point I am asked to refer to is the question of the up-to-dateness or otherwise of the apparatus throughout the London exchanges. Our Committee was very courteously invited to visit the system in London and to see for themselves how things were done, and they visited the Avenue Exchange and were very interested by what was shown to them on that occasion. But the very fact that the Avenue Exchange is, as I understand, in such good shape points at all events to the other exchanges not being similarly well equipped, and we understand that alterations are being made, improvements are going on. But the Committee fears that in a large measure the apparatus in parts at all events of London is in many ways obsolete, and is of opinion that it is very important that changes which we believe are going on should be pressed forward in order to bring the whole of the London system up to the same standard of excellence as exists in the Avenue Exchange.

The POSTMASTER-GENERAL: Can you mention any particular places?

Mr. FAITHFULL BEGG: I am not authorised to, and I am not sure the Committee has the information. I was not present when this visit was paid.

The next point is the trunk service, and there we think it may be admitted that the trunk service is beginning in certain directions to show improvement, but those of us who visit America are quite satisfied that the trunk service in this country is not in anything like the shape of the trunk service in the United States. I do not think anyone who visited the United States would say that the trunk service here could be compared with the trunk service over there.

The POSTMASTER-GENERAL: Would you be ready to pay the fees that they charge in the United States?

Mr. FAITHFULL BEGG: I knew you would ask that question. Personally, yes. I have always been one of those who said, "Give me a good service and I don't care what you charge for it." But I know that is the answer and it is a very good one. I have some details with regard to the delays which occur, but I think I may leave that point by simply saying what I have said, that we do not consider that the trunk service in this country is what it ought to be, and we hope that the trunk service will be materially improved in the early future. The importance of the trunk service I need not emphasise, because in business now trunk calls have become and are becoming a very important part of their work.

I was asked to mention specially what the Committee noted with great pleasure—the general arrangements for the supervision of operators at the Avenue Exchange, the method of observing them without their knowing they are being observed, so as to see that their work is properly carried out, and in connection with that it is hoped that the rest of London will be given the benefit of similar advantages as soon as possible.



Digitized by Google

The next point is the question of the inconvenience of the "pillar" instrument. There is a good deal of technicality in connection with that. I am not sure that I personally am qualified to go into the particulars of that, but what I am asked to mention is the irksomeness of lifting the instrument about, which was unnecessary in the case of the old hand-combination instrument, and there is also one point in connection with it which is of great importance. We understand that it is impossible to connect an exchange with an extension for a long or short period of time and thereby dispense with a switchboard attendant. I am told that is so, and that it is a grievance which is felt considerably in many quarters. I understand you have already recognised in some way the reasonableness of this, and that efforts are being made to see whether some improvement cannot be brought about.

There is one other very important point to which I am asked to refer, and that is the question of the rates themselves. Now at the time of the transfer I think it may be fairly said that specific assurances were given or general assurances that the result of the taking over by the Post Office would not be anything in the nature of a general advance in rates, and I think the public, rightly or wrongly, concluded that as a matter of fact they would get their telephones for less. I never shared that view, but I think it was a more or less general view, and we are told—and I think there is evidence throughout the country—that there are very serious complaints of increases in rates. I have been given one instance—I am prepared to admit that it is probably exceptional, but I was asked specially to mention it. It was a case of a certain firm which had two lines with two internal extensions and two external extensions, and paid for an unlimited service £20 per annum for the two lines. Now that firm has three lines with five internal and three external extensions for which you charge £57, and the service is limited. I only give that on the authority of the Committee, but I am quite sure the Committee would not have put it forward without chapter and verse for it. Generally speaking, the Committee is of opinion that it can be shown that the changes which have taken place have in the main been in the direction of a considerable increase in rates. What we ask is that there should be an inquiry into that point in order that it may be really ascertained whether or not there has been anything that can be called a general increase in rates since the Post Office took the system over. I understand, Sir, that you yourself have indicated that you would not be averse possibly to that course being taken, and in any case we desire most heartily to support that suggestion.

Now these, Mr. Samuel, are all the points I am asked to refer to except that I want to make one inquiry, and that is if you can tell us generally how the automatic system is developing and whether you have reasonable expectation that the working of it will be successful and that the extension of it may be looked forward to. I do not think the public has very much information about it, and it would be interesting, if you felt it possible, to give us some information as to what you think the future of that system will be.

I hope I have stated these points temperately and not said anything that even the Department might feel was unduly harsh upon them. While we sympathise with these complaints and sympathise with the irritation which they have caused, we are quite aware of the extreme difficulties of the situation, and I conclude by saying that the real object and aim of the Chamber and of the Committee is not to make trouble in any sense or form, only to criticise so far as circumstances justify and put itself at the disposal of the Department in any possible way with a view to helping in the solution and removal of those difficulties to which I have been privileged to refer.

Mr. STANLEY MACHIN: Mr. Samuel,—Mr. Begg has stated very fully the chief points which the London Chamber of Commerce wish to bring before you. Perhaps, therefore, I shall not be misunderstood if I briefly refer to certain details, endorsing as I do all that he has said, especially in connection with the way in which the Chamber approach you in this matter. We feel that it can only be to the advantage of all concerned that the users of the telephone—and I think we may be regarded as representing absolutely the users in the City of London—should come into contact with the heads of the Department in the most friendly way.

Mr. Begg referred to the trouble caused in regard to calls by there being no court of



Digitized by Google

appeal; there seems to be some difficulty as to how this could be adjusted. On my own responsibility I would suggest the possibility of some advisory committee being appointed to adjudicate upon these points, which would protect the Department from litigation and satisfy the users that their individual grievances were being dealt with carefully and impartially. That is simply an idea that has occurred to me, and I leave it with you for what it is worth.

I should like to mention a little practical experience which, as a manufacturer, I have had during the last twelve months. It certainly does go to show that telephone users have had very much more trouble recently than in the past. Reference was made to the service in the United States of America, which which you are no doubt far better acquainted than I am. We are informed that a trunk delay of even a few minutes there becomes a matter of inquiry, whilst here it is not an uncommon thing for us to have delay of half or three quarters of an hour on a trunk call. I need hardly say that such conditions render the telephone almost useless: it is quite impossible for traders to wait twenty minutes, half an hour and oftentimes much longer still for a possible reply to their call: the telephone becomes practically useless. Then, sir, the number of false calls —that is, rings where the subscriber called is not wanted at all—provides an experience which to us is new to the last few months, but which does not decrease and is a source of very great annoyance. These matters are perhaps trivial, but we think they should have special attention.

Then, again, it would seem that the Department is called upon to undertake more than it can carry out. Yesterday I had occasion to ring up the secretary of an organisation and could get no reply at all, and the reason, I hear to-day, is that the telephone has not been fixed in his new office. It is in the building, but he is told that it cannot possibly be ready for use for a fortnight. There may be some special reason in this instance, but it does seem strange that in the City of London a commercial undertaking must wait a fortnight, although the wires are already in the building, before an instrument can be made fit for use.

Mr. Begg referred to the question of cost. I here speak for myself, but I really think I express the opinion of City business men when I say that we consider that efficiency is absolutely of the first importance, not regardless of cost but regardless of any reasonable cost. With us time, as with you, is very valuable, and efficiency and reliability are to us of very much more importance than a nominal increase of cost, although of course I do not suggest that the present charges are too low.

May I again say that our object is to assist the Department in every way, and if some advisory committee can be formed such as I have suggested to deal with complaints, so that representative commercial men may be constantly in touch with your department and bring before you any complaints or suggestions, I think it would prove more satisfactory.

Mr. J. S. DANIELS: I simply rise to second all that has fallen from Mr. Begg, and particularly to emphasise one of the points he has mentioned, that, namely, having reference to the legal position from the Post Office point of view and from that of the subscriber. I think it is an inequality which should be remedied by some means, and I would suggest that the means should emanate from the Post Office itself; it is a very unreasonable thing for a man to be told he has no remedy whether his accounts are correct or not. I have a suggestion to make which I think might help to alleviate much of the trouble caused at present with regard to the payments; instead of yearly payments I should like to suggest that you should accept, from subscribers, half-yearly payments or even quarterly payments; if you should adopt that suggestion I anticipate in the space of two or three years that half of your troubles with regard to accounts would be wiped off your slate. Otherwise, I wish to support everything that has fallen from the two previous speakers. The Postal, Telegraph and Telephone Committee have done their best to bring the question impartially before the Council of the Chamber, and their recommendations and views have been generally adopted.

The POSTMASTER-GENERAL: Lord Southwark and Gentlemen,—I speak quite sincerely when I say that I am grateful to you for coming here to-day and for representing the



Digitized by Google

views of commercial men of London with respect to the development of the telephone system. I am at one with you in recognising that in the organisation of the modern commercial world, and for social purposes as well, an efficient and reasonably cheap telephone service is not merely a desirable thing, but is an absolutely essential thing, and any steps that are taken by the representatives and leaders of the commercial community to assist my department and myself in providing the public with that essential thing are most cordially welcomed by us. I have no complaint to make of the manner in which the considerations you wish to bring before me have been stated to-day. You recognise that difficulties have existed arising out of the transfer of the vast system of the National Telephone Company to the State, for which allowance must be made.

I welcomed very cordially the statement of Mr. Faithfull Begg that the flat rate is recognised not to be the ultimate sound basis for charging for telephone service, and I was grateful for the expressions of approval that he made with regard to the supervision of operators at the Avenue Exchange. I am informed that the supervision is precisely the same at all the Exchanges, and that therefore any testimony to its excellence at that one Exchange must be applied to our telephone system generally.

There are, of course, complaints with regard to the service, and because I have, from time to time, suggested in Parliament and elsewhere that a proportion of these complaints, especially some of those that are made by writers in the Press, are exaggerated, it has therefore been represented that I regard the present telephone system in London and in the country generally as perfect, and that all complaints are ill-founded. That is not so; I have indeed said the opposite in most emphatic terms again and again, and if I think it is my duty to point out that many of these complaints are in fact untrue, have no basis at all, and that many others are couched in most exaggerated terms, that does not prevent me, nor does it prevent my officials, from recognising to the full that the telephone service has not yet reached that standard of efficiency generally which we should desire to see it attain, still less has the telephone service in the United Kingdom arrived at that development, from the point of view of the number of subscribers served, which it ought to reach in a busy and thriving industrial country such as that in which we live. Having made these few preliminary remarks, let me deal one by one with the points which you have been good enough to bring before me.

The first related to the terms of the contract which telephone subscribers are required to sign as a condition of the provision of the service. I quite realise that when a subscriber thinks that the number of calls charged against him is more than it accurately should be, he may feel a sense of grievance if he finds that his agreement provides him with no form of legal remedy, but when you come to consider the alternative, we are faced with very great difficulties. I believe it is the case, so far as is known by my Department, in every telephone system throughout the world, that subscribers are required to accept the records of the service as the basis of the accounts which they receive. As I mentioned in a brief interruption when Mr. Begg was speaking, we deal now with about a million calls a day in London, and if it were left for us to prove before a court of law whether or not particular calls had been made on particular days, you can see how almost impossible it would be to conduct the service at all. The system which is at present in use for registering calls in London is the same as is in use in New York and in every large American city. It was in New York a few years ago minutely examined by a body of experts and accountants employed by a committee of the New York Merchants' Association, and they reported that the system was as exact and accurate as any that could be devised. And within the last few days the Advisory Committee which has been formed in Liverpool, consisting of representatives of the Liverpool Corporation, the Chamber of Commerce, the Docks Board, the Cotton Exchange, and other representative bodies in Liverpool, made an inquiry in Liverpool with respect to the system there, which is the same as that in use in London, and the Chairman reported a few days ago to the Liverpool Chamber of Commerce that the method in vogue at the Post Office for registering the number of calls made was found to be perfectly satisfactory. A Committee of your Chamber in 1908 also investigated the system in London and reported favourably upon it. Whenever any subscriber makes complaints with regard to the accounts rendered to



Digitized by Google

him, in every way possible care is taken to check the working of our automatic meters. They are tested by the engineers; the account books are examined for clerical errors, and if necessary test checks are kept on the subscriber's lines in order to ascertain what calls are actually being made. On the other hand, subscribers very frequently, while they are convinced that not more than a certain number of calls are being made, may be unaware of the use that is being made of their telephones in their absence by their domestic servants in their houses or by clerks or office boys in their offices; and cases are not infrequent where it has been ascertained on more careful inquiry that the subscriber himself who made indignant protest as to the number of calls for which he was charged, was not aware of the surreptitious use that was being made of his instrument without his authority and in his absence. That is one of the reasons why complaints are made. There is another reason. In our system we do not charge, of course, for ineffective calls. If a subscriber makes a call and is given a wrong number, and then calls a right number, if he does not inform the operator that he has been given a wrong number, he may be charged for both calls I propose to send a circular to subscribers drawing their attention to this, and mentioning that this is one of the safeguards against being charged unduly on account of ineffective calls.

The suggestion has been made that there should be a meter put on the subscriber's instrument which should work jointly with the meter at the exchange and enable him to see day by day precisely what his account is going to be. There have been the greatest engineering difficulties in devising such a meter. It would be quite easy to devise a meter which would register a call every time the subscriber rings up, but that would not be satisfactory, because it would register ineffective calls as well as effective ones, and to devise a meter which would only register when then there is an effective call made would mean either bringing in the operator at the exchange or else endowing machines with powers of discrimination which even the ablest inventor has not been able to provide them with. In no system in the world are such meters in general use. I have been pressing upon my Engineering Department for some months past, however, the advisability of devising some meter which would get over these difficulties, and they have been at work endeavouring to provide a meter which would serve all the purposes required, which will not involve costly and revolutionary changes in the existing equipment, and which will not be unduly expensive; and they are at the present time hopeful of having provided a device which will meet these requirements. It is now under experiment, and I should not like to pledge myself until the experiments have advanced further. The instruments have been made and they are now in use, and the experience so far enables one to be hopeful that they may on further test prove to be practicable, and if this turns out to be so I shall be able before long to offer to subscribers a meter—of course they will have to be charged a little extra for it—which will register calls on their own instruments, so that they can make representations if they think the record is mounting up against them unduly quickly. I will also consider the suggestion made by Mr. Stanley Machin, which is new to me, that some form of committee should be established to which complaints might be referred.

The next point which was mentioned was the provision of additional junction lines. It was suggested that the number of engaged calls in London is swollen partly through the insufficiency of junction lines. Well, the operators are instructed that whenever they are unable to effect communication owing to a junction line being engaged they should say "junction engaged" and not "number engaged." That is the instruction to them, which should undoubtedly be observed, and we take whatever means are in our power to secure that it should be observed. You may say that that cannot be so, because the number of cases in which that answer is given is so extremely small.

Mr. FAITHFULL BEGG: I have never heard of it before.

The POSTMASTER-GENERAL: It is sometimes given. But it is also the case that the number of calls which fail through the insufficiency of junction lines is exceedingly small. I think the Committee which went to investigate the Avenue Exchange were under a misapprehension. They inquired whether the subscribers were told that the lines were engaged when junction lines were not free, and they were informed that sometimes it



Digitized by Google

might be the case. And that is quite true, but it is very rarely the case indeed. As you know, we have a most elaborate system of observation in order to enable us to collect statistics. 44,000 calls have been observed during the first six months of this year by the clerks whose duty it is solely to observe calls and collect statistical material. It is found that the number of calls which were ineffective through junction lines being engaged has steadily fallen. In 1907 and 1908 the number of calls which failed from that cause was from 1 to 2 per cent. In 1909, 1910 and 1911 it never rose above 1½ per cent. In 1912 it fell from 1 per cent. to less than ½ per cent. during the latter half of that year. That has been due to a very rapid increase in the number of junction lines provided. In 1908 there were provided in London 672 new junction lines; in 1909, 674; in 1910, 1347, in 1911, 2138. After the transfer we had to provide a largely increased number of connections with the ex-National Telephone Company's Exchanges and the number of new junctions increased in 1912 to 2648, so that the number in that year was nearly four times as many as three or four years previously. We caught up arrears very largely last year, and this year it will not be necessary to provide quite so many lines, but in the first six months 992 have been provided.

The deputation suggested that the London Telephone Exchanges should be modernised. Well, there again we are taking action of the most extensive kind. During the present financial year I shall be spending altogether, taking the country as a whole, about £3,000,000 in new telephone construction and development out of capital in this one year, that is apart, of course, altogether from the purchase money of the National Telephone Company's plant, and apart from all expenditure on ordinary renewals. It is for new exchanges, new trunk lines, and new subscribers' equipment. Before long I shall be going to Parliament to ask for authority to borrow another £10,000,000 for the development in the next few years of the national telephone system. I should like to say that it is anticipated it will not be necessary to go to the money market for this money, but that it can all be provided from funds in the hands of the National Debt Commissioners without floating any new Government loans.

Already in London all the principle exchanges, except the Bank Exchange, are of modern type, and they differ only in small details from the Avenue Exchange which your deputation visited and the equipment of which they approved. All except the Bank Exchange are of the type which is in use in New York and in the principal American cities, and represent the highest development of the manual switchboard system. Plans are now being made which will involve the scrapping of the equipment at the Bank Exchange and the transfer of the subscribers to a more modern exchange. We have scrapped the Company's Westminster Exchange and their old Avenue Exchange, and have provided newer and better exchanges. Since the transfer, sixteen of the Company's Exchanges in the outlying parts of London have been closed on account of their being not so efficient as modern exchanges should be, and the subscribers transferred to properly equipped exchanges. Five of the old Post Office Exchanges—Wimbledon, Chiswick, Ilford, Reigate, and Epsom—have been replaced by new exchanges. In the centre of London two wholly new exchanges have been opened—Regent and Park—with a capacity of 10,000 lines and 8000 lines respectively. A new Victoria Exchange with a capacity of 10,000 will replace the existing Victoria Exchange in the present autumn. Before the end of the year there will be a new exchange—Museum—in the neighbourhood of the British Museum, with a capacity of 10,000 lines. Before the end of next year we shall have two more new exchanges, each of 10,000 lines, which will be called Charterhouse and Tower. In addition to all this there have been considerable extensions made to twenty-eight other exchanges in London in order to meet increasing demands for service. When it is realised that all this tremendous expansion in buildings and equipment has been made at the very time when there was the difficulty caused by the amalgamation of two great staffs, and at the time when the higher officials were largely engaged in the arbitration proceedings to settle the price of the Company's plant—the biggest arbitration on record—I think it will be realised that the Department has been doing its very utmost to cope with the immense task placed before it.

With respect to automatics, the experience has been that the automatic system is of



Digitized by Google

most value where most of the calls are to subscribers attached to the same exchange, and not where most of the calls are from one exchange to another exchange. If you have an ordinary provincial town of moderate size where all the subscribers are connected to one exchange in the centre of the town, that is the ideal field for the use of automatic apparatus. But where you have, as in London, a system where the majority of the calls are made from one exchange to another exchange, there the use of automatics is not so expedient, and for that reason mainly at the present time we are not proposing to instal automatic apparatus in these new London exchanges. It would not be, so I am told, from an engineering and financial point of view, expedient to do so. We have experimented at Epsom with an automatic exchange, and the experiments have been very successful, and I am informed that the subscribers are quite satisfied. We have also experimented on ourselves here and established an Official Exchange on automatic lines. The instrument is here on my table. We have experimented on the principle of *fiat experimentum in corpore vili*, and our own experience here has been satisfactory. We are also proposing to instal automatic apparatus in four or five provincial exchanges in various parts of the country, some up to 10,000 lines, and tenders are being asked for from contractors who provide automatic apparatus.

The deputation also raised the question of accelerating the trunk line service. Nearly half the traffic on the trunk lines in this country is concentrated on two hours of the day, and the other half is spread over the remaining twenty-two hours. That fact makes proper provision for trunk line service a very difficult problem, because, if we are to provide a no-delay service during those two hours——

Lord SOUTHWARK: Which are those two hours?

The POSTMASTER-GENERAL: In the middle of the morning, ten to twelve—or anything approaching a no delay service, we shall have an immense amount of plant, representing a vast expenditure of capital, lying idle, in fact half the plant during the other twenty-two hours of the day, and it will easily be seen by a body of business men what a serious financial proposition that is. In the United States of America the fees for trunk service are from two and a half to three or four times as high as in England, and while we could provide an exceedingly rapid trunk line service if we charged similar fees, even allowing for the higher prices in America, I think the public would complain if we doubled the cost of our trunk line service. But with our present fees we are making very large extensions. You are no doubt specially interested in the trunk line service from London. There are at present 520 trunk lines coming into the Trunk Exchange in this city. We are adding 30 per cent. now at once: the lines are being constructed; 180 lines are being added to the existing 520, increasing the number by 30 per cent. immediately. I am spending £300,000 on a new underground cable from London to Birmingham, which will provide three times the present number of wires when it is completed, for communication between London and Birmingham and the North—it will serve Manchester and Liverpool—and the West of England. It will take some time to carry through an engineering work of such magnitude as that, but the work is about to be put in hand. The sum which is being spent now on the development of the trunk service throughout the country is £1,800,000 and while a good deal of that is for trunk services not directly communicating with London, it will improve the service throughout the country and indirectly affect the trunk service with London.

The deputation raised the question of the supervision of telephone operators and the need of greater efficiency. Here again we have been passing through a period of transition, on account of the absorption of the National Telephone Company's staff. Their operating staff were paid considerably less wages than our operators were paid; the scale of pay for their supervisors was only about the same that we pay to our rank and file operators. Further, the hours were different for the telephone operators, the meal intervals were different and were less generous, and owing to the Telephone Company's operating staff being put upon the Post Office conditions we had to employ a large number more girls to do the same amount of work. In addition to that the natural growth of work has involved a great increase of staff, and as a result, between January 1st, 1912, and May 31st of this year we have had to bring into the London service no fewer



Digitized by Google

than 1335 new women operators as well as 201 new male night operators. All these girls and men have had to be trained and have had to be made accustomed to their duties. This increase of staff is also partly due to the fact that we give longer holidays than the Company did, a fact which makes the service more expensive but should make it more efficient. There is one supervisor to every eight operators continuously watching the work of the girls, and, as you know, the detailed working of the system is most carefully checked by the staff of clerks whom I have already spoken of, who without the knowledge of the operators are able to keep a watch on the way in which the work is being done. The average time before a call is answered is now about five seconds, taking London as a whole, and the percentage of effective calls on the London system, which was 65 per cent. last year, is now raised to 70 per cent. partly owing to better supervision.

One other point is the pillar instrument. The pillar instrument is the standard form used in connection with the central battery system throughout the world. It is universally in use in the large cities of the United States which are held up to us as models for imitation, and where the working has frequently been examined by officers of my Department. I have officers in the United States now being educated in American methods, and visits are frequently paid by the superior officers of the Department. And I myself in a few weeks' time am about to visit Canada, and, I hope, some of the principal cities of the United States, and shall there obtain such knowledge of the telephone working as I am able to secure.

The hand-combination instrument has an electrical efficiency of only 70 per cent. of the pillar instrument, and that is the only reason why the pillar instrument has been installed. The hand-combination instrument is much more comfortable for use, and we should not have pressed the other on the subscribers, nor would it have been done in the United States, were it not that the hand-combination instrument is only 70 per cent. as efficient as the other. For some years we have invited manufacturers and inventors to furnish us with a hand-combination instrument as efficient as the pillar, but none has been forthcoming. A fairly satisfactory instrument has lately come under notice and an order for 500 has been placed. It is not quite as efficient, but we are experimenting, and I should like to say now, in case it should come to the ears of any ingenious inventor or manufacturer, that we should most cordially welcome any hand-combination instrument which can be devised which is as efficient for telephone purposes as the pillar instrument.

With respect to rates, my policy has been to effect no change at all in the existing system of rates until the whole can be overhauled. I think that you are under a misapprehension if you have been informed that there has been any general change, whether by increase or by decrease, in the charges for telephone service. What has happened has been that the policy prior to the transfer has been continued, namely, that where a subscriber has had a flat rate service, but wishes to change his service or to extend it to any considerable degree, he must then go on to the measured rate. That has been our policy for some time past, and that policy has been continued. If the change is of a trivial character, we do not disturb our subscriber, but if he is putting in a new equipment, and extending the service, we seize the opportunity to bring him on the measured rate, which is, as Mr. Faithfull Begg has very candidly stated, the right system of charge for telephone subscribers. And that is the explanation of the particular cases which he has mentioned to-day. Otherwise there has been no general change, and I do not think that it is desirable or necessary to have an inquiry whether there have been any considerable changes, because we know there have been no such changes.

With regard to the future, the case is different. There, indeed, we are contemplating certain alterations. The suggestion made by Mr. Daniels that we should allow payment at shorter intervals than a year is under serious consideration. I agree with the expression of opinion made to-day that efficiency is more important than cheapness; and while it would be wrong to charge subscribers more for the service than it actually costs to provide, with a small profit to the Exchequer in consideration of the large amount of public capital involved, at the same time I think it would be a grievous error, in the hope of getting some small measure of popularity by immediate reductions, either to imperil



Digitized by Google

the future efficiency of the service by lowering the standard of operating or the standard of equipment, or to run the risk of financial loss in the future. For that would fall on the taxpayers of the country, and at the same time would render future Governments unwilling to allow that further extension of telephone supply and that large expenditure of public capital which is desirable if the system is to be as wide-spread as it should be.

It will be necessary if the new scale of rates is not generally accepted—and I am afraid it would be unduly sanguine to expect that any new scale would be generally accepted—it will be necessary to have an inquiry by a committee, because it would obviously be very wrong for me to force on the community at large, without opportunity being given to your Committee and other similar Committees to make representations, a new scale of rates. It is necessary to make careful inquiry into the cost of the service, and we are invoking outside actuarial assistance with a view to ascertaining what different forms of service do cost, because it is important that we should put our charges on a basis which future experience will show to be justified. A mistake now may have the most disastrous effects in the future. While I am anxious to announce the new scale as soon as possible I do not want those engaged on the work to be unduly hurried, with the result that errors, and irreparable errors, might be made.

I am very grateful to your Committee for coming here to-day and making these representations. I am anxious that I and my Department should keep in close touch with your Chamber, if you would allow us to do so. I believe it is of immense advantage that the Department should be in communication with the leading representatives of commercial interests in the great cities of the country, and on my own initiative in seventeen towns already telegraph and telephone advisory committees have been set up. Usually the Chamber of Commerce has taken the first step locally at my request and has added to its own representatives members of the local corporation, dock board, if there is a dock board, cotton exchange, wool exchange and so forth, so as to form committees really representative of the business of the town. Seventeen of these committees have already been formed and twelve more are in process of formation. The local district managers and postmasters are instructed to render them every assistance, and Mr. Ogilvie, the indefatigable head of the Telephone Department here, has visited many of these cities and answered inquiries and complaints. We are providing the committees with statistics of the service and with statements of the developments we have in prospect, and I am quite sure that it will be of immense value to the Department, and therefore to the public, if frequent communication can be maintained between such committees and the Department. What has been done elsewhere should, *mutatis mutandis*, be done in London. Of course, London is so vast, the interests concerned are so great, the number of representative bodies so large, that possibly it may not be practicable to form a combined committee of all the associations and public bodies concerned. That, however, you might perhaps yourselves consider. At any rate your Committee represents the Chamber of Commerce, which as I know—I was myself for some years a member in order to learn what was being thought by commercial men—is very representative of the business men of London, and we shall be most happy to act with you as we are acting with combined committees in provincial towns. You have only to ask and the heads of the telephone service will be most happy to meet you and explain any points. If you desire to visit our exchanges, you will be most welcome visitors. If you desire statistics or information as to future plans they shall be furnished to you. I hope the Department and yourselves, working hand in hand, both having in view a desire to serve the public interest, may effect a continuous improvement in the telephone service of the metropolis.

Lord SOUTHWARK: Mr. Samuel, on behalf of my colleagues here, I have to thank you for the very cordial reception you have given to the deputation, and for the very practical, satisfactory, and important public statement that you have made to-day. I am sure it must be gratifying to my colleagues, and I am sure it will also be very interesting and most gratifying to the public at large. I can assure you that it has been our desire to render assistance. The action that we have taken in the past seems to have been a very successful one, because you have so cordially received our suggestions and dealt with them in such a kind and business-like way. I am sure my friends were very gratified when



Digitized by Google

you referred to the increase of junction wires. With regard to the trunk service, I asked what hours were the busy ones, because I think if it was known to the public at large that the service was most used during two hours of the day, many could use the service at other hours. We are very much gratified by your closing observations with regard to the Advisory Board. We realise that you appreciate the services that the Telephone Committee of the Chamber of Commerce have rendered, and that it is the sort of service you would like to have continued. Whether we are working in the most perfect way or whether we can improve upon it will be considered.

The deputation then withdrew.

---

# STAFF CHANGES.

## POST OFFICE ENGINEERING DEPARTMENT.

PROMOTIONS.

| Name. | From. | To. | Date. |
|---|---|---|---|
| Stannage, G. | Exec. Engr. S. Eastern Dist. | Asst. Supt. Engr. S. Wales Dist. | 1 : 7 : 13 |
| Comport, G. H. | Exec. Engr. Scotland W. Dist. | Asst. Supt. Engr. S. Midland Dist. | 1 : 7 : 13 |
| Youngs, C. J. | Exec. Engr. S. Wales Dist. | Asst. Supt. Engr. S. Wales Dist. | 1 : 7 : 13 |
| Terras, J. S. | Exec Engr. N. Wales Dist. | Asst. Supt. Engr. N. Western Dist. | 1 : 7 : 13 |
| Lakey, T. | Asst. Engr. N. Midland Dist. | Exec. Engr. Eastern Dist., Norwich Sect | 1 : 7 : 13 |
| Wise, F. H. | Asst. Engr. Eastern Dist. | Exec. Engr. Eastern Dist., Ilford Sect. | 26 : 6 : 13 |
| Patterson, T. | Asst. Engr. S. Midland Dist. | Exec. Engr. S. Eastern Dist., Croydon Sect. | 1 : 7 : 13 |
| Scott, W. | Asst. Engr. S. Wales Dist. | Exec. Engr. S. Wales Dist., Tech. and Develop. Sect. | 1 : 7 : 13 |
| Horton, F. D. | Asst. Engr. Engr.-in-Chief's Office | Exec. Engr. Scotland W. Dist., Hamilton Sect. | 1 : 7 : 13 |
| Gillett, E. J. | Asst. Engr. N. Eastern Dist. | Exec. Engr. N. Wales Dist., Birmingham (Outer) Sect. | 1 : 7 : 13 |
| Tattersall, J. T. | Asst. Engr. N. Eastern Dist. | Exec. Engr. N. Eastern Dist., Hull Section | 1 : 7 : 13 |
| Gill, R. | Engr. 2nd Cl. N.E. | Asst. Engr. N.E. | 1 : 7 : 13 |
| Pittman, W. C. | Engr. 2nd Cl. N. Mid. | Asst. Engr. N. Mid. | 11 : 7 : 13 |
| Mears, T. | Engr. 2nd Cl. E. in C.O. | Asst. Engr. E. in C.O. | 1 : 7 : 13 |
| Butterfield, J. C. | Clerk 2nd Cl. N. Eastern Dist. | Clerk 1st Cl. Scotland E. Dist. | 7 : 9 : 13 |
| Devey, J. E. | Clerk 2nd Cl. N. Midland Dist. | Clerk 1st Cl. N. Wales Dist. | 7 : 9 : 13 |
| Cooke, J. | 3rd Cl. Clerk Provs. N.W. | 2nd Cl. Clerk Provs. N. Mid. | To be fixed later. |
| Hewins, H. J. | 3rd Cl. Clerk Provs. N.W. | 2nd Cl. Clerk Provs. N.E. | ,, |



Digitized by Google

TRANSFERS.

| Name. | Former. | | Present. | | Date from which to take effect. |
|---|---|---|---|---|---|
| | Rank. | District. | Rank. | District. | |
| Martin, J. | Asst. Supt. Engr. | S. Wales | Asst. Supt. Engr. | S.E. | 1 : 7 : 13 |
| Smart, E. V. | Asst. Engr. | E. in C. O. | Asst. Engr. | London | 1 : 8 : 13 |
| Taylor, J. L. | ,, | London | ,, | E. in C. O. | 1 : 8 : 13 |
| Lawson, R. | Proby. Sub-Engr. | ,, | Proby. Sub-Engr. | ,, | 1 : 8 : 13 |
| Gill, B. J. | 1st Cl. Clk. (Provs.) | Sc. E. | 1st Cl. Clk. (Provs.) | N. | 17 : 8 : 13 |

RETIREMENTS.

| Name. | Former. | | Particulars. | Date from which to take effect. |
|---|---|---|---|---|
| | Rank. | District. | | |
| Lougheed, W. | 3rd Cl. Clk. | E. in C. O. | Superannuated | 19 : 7 : 13 |
| Hudson, J. A. | ,, | E.L. and P. | Apptd. District Supt. of Post and Telegraphs, North. Nigeria | 22 : 7 : 13 |

DEATHS.

| Name. | Rank. | District. | Date. |
|---|---|---|---|
| Grace, H. | Engr. 2nd Class | E. in C. O. | 30 : 6 : 13 |
| Taylor, T. | 3rd Cl. Clk. | S. Mid. | 9 : 5 : 13 |


## BOARD OF EDITORS.

J. SINNOTT, M.I.E.E., Chairman.
A. W. MARTIN, A.M.I.E.E.
A. C. BOOTH.
J. W. ATKINSON, A.M.I.E.E.
A. O. GIBBON, A.M.I.E.E.
W. T. HARRIS.
W. CRUICKSHANK, A.M.I.E.E., Managing Editor.


## COMMUNICATIONS.

All Remittances and Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, G.P.O. West, London, E.C.

A few copies of each of the following numbers of the JOURNAL are required by the Board: Part 1, Vol. 1; Part 2, Vol. 3; Part 1, Vol. 5, and Part 2, Vol. 5. Full price will be paid for copies in good condition, or other numbers can be sent in exchange. The journals may be sent to the Managing Editor direct, or through the local agents.



Digitized by Google

Digitized by Google

DIGGING THE TRENCH FOR THE NEW ANGLO-GERMAN CABLE. THE CABLE SHIP "STEPHAN" IS SEEN LYING CLOSE INSHORE.

Digitized by Google

THE
Post Office Electrical Engineers' Journal

# A NEW ANGLO-GERMAN TELEGRAPH CABLE.

By A. C. Booth.

The Norddeutsche Seekabelwerke Aktiengesellschaft have constructed and laid by means of their cable ship "Stephan" (see frontispiece) a new 4-wire submarine telegraph cable (1) from Mundesley in Norfolk, near Cromer, to the island of Norderney off the north-west coast of Germany. The work of laying the cable was carried out on the 18th and 19th of September last.

The cable is connected to the repeater station at North Walsham (2) by four copper wires, each 150 lbs. per mile, but this section of five miles will shortly be replaced by an underground lead-covered paper-insulated cable, having the same size of conductor. On the German side the cable is continued to the mainland, and thence by underground to the cable repeater station (3) at Emden with similar gauges of gutta-percha-covered conductors. The object of the cable sections on the land is to avoid disturbances produced on aërial sections by atmospheric changes and other causes to the somewhat difficult balances which have to be maintained on these lines.

The new cable from Mundesley to Emden is 274·287 nautical miles in length; each core has a resistance of 1753 ohms and a capacity to earth of 93 microfarads. Each conductor consists of a central solid wire surrounded by twelve smaller ones, the former being 1·65 mm. and each of the latter 0·55 mm., giving a total weight of 180 lb. copper per nautical mile. The gutta-percha covering is 150 lbs. to the nautical mile. The usual brass taping is provided.

The four wires will be utilised for improving the means of communication between England and Germany, but the actual

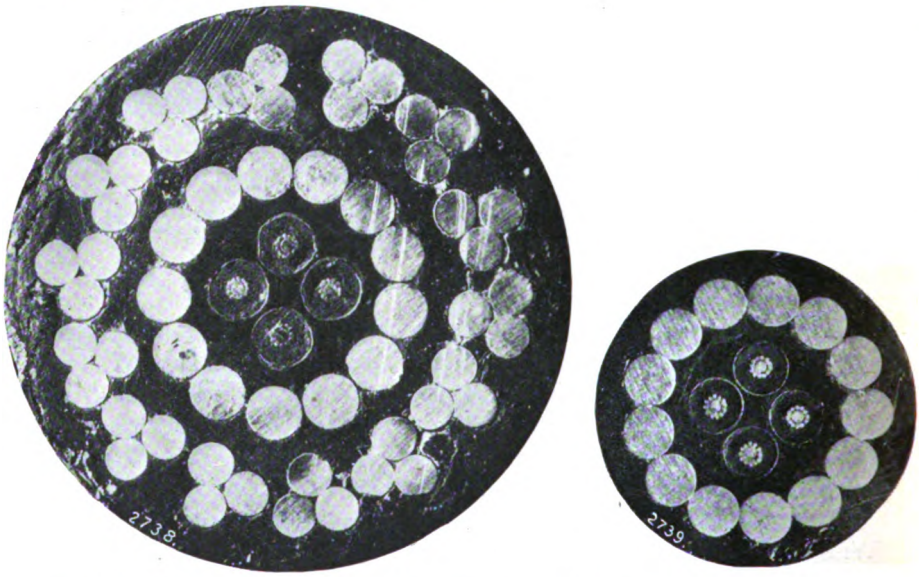


Digitized by Google

towns which the cable will serve have not yet been agreed upon. There will, however, be a direct circuit between London and Leipzig.

The apparatus that will be employed on the new cable will be either Baudot or some other apparatus giving a greater output than the Hughes.

This cable forms the sixth four-wire cable working direct between England and Germany. The two earliest ones pass *viâ* Lowestoft, and the other three (*viâ* North Walsham) leave the coast at Bacton, a village situated two miles south of Mundesley. Details of the six cables are given in the following table:



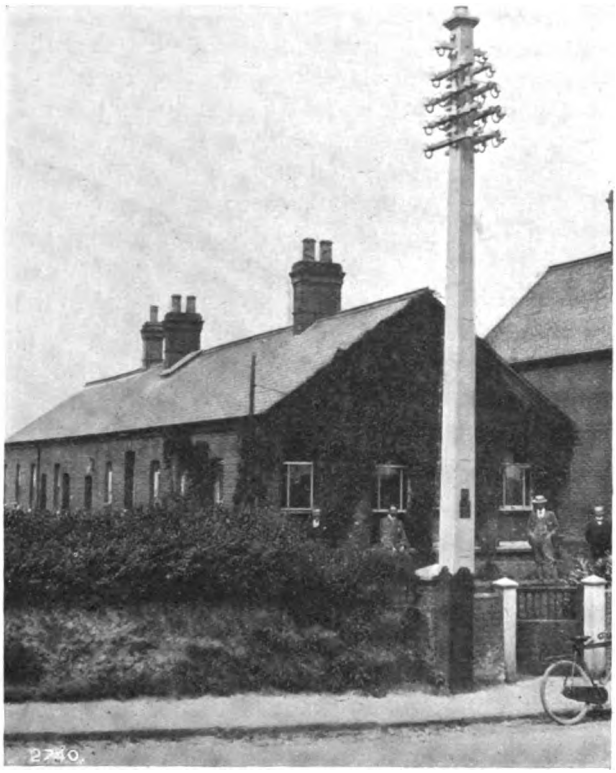

I.—Sections of the new Anglo-German Cable: Shore-end and Mid-Ocean. Full Size.

*Anglo-German Cables.*

| Cables. | Date laid. | Length in nautical miles. | Total resistance in ohms. | Capacity wire to E. in microfarads. | Weight in lbs. per nautical mile. | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | | | Copper. | G.P. | |
| Lowestoft–Norderney | 1866 | 234·2 | 2715 | 75·4 | 107 | 150 | To Norderney Post Office. |
| Lowestoft–Borkum | 1871 | 243·3 | 2578 | 73 | 107 | 150 | To Emden |
| Bacton–Borkum I | 1891 | 241·4 | 2578 | 73 | 107 | 150 | ,, |
| ,, II | 1896 | 253 | 1620 | 94 | 180 | 150 | ,, |
| ,, III | 1901 | 267·5 | 2385 | 103 | 130 | 130 | ,, |
| Mundesley–Norderney | 1913 | 274·3 | 1753 | 93 | 180 | 150 | ,, |



Digitized by Google




**2.**—North Walsham Repeater Station.

**3.**—Post Office and Repeater Station, Emden, Germany.



Digitized by Google

A few details of the cable-ship "Stephan" may be of interest. She was built at Stettin in 1902, and was named after the first Postmaster-General of the German Empire. Her carrying capacity is 5000 tons of cable in four tanks. The length of the ship is 380 ft. 9 in., the breadth 48 ft., and the depth 32 ft. 9½ in. She is equipped with twin engines developing 2400 h.p., and when loaded can steam 11·5 knots. The personnel numbers 120.

The "Stephan" is the second largest cable-ship in the world, ranking next to the C.S. "Faraday," belonging to Messrs Siemens Bros., Woolwich, which has been already illustrated in this JOURNAL. The Norddeutsche Seekabelwerke Aktiengesellschaft also laid the Bacton–Borkum III cable by their ship the "Podbielski."

# PROGRESS OF THE BAUDOT SYSTEM.

By A. C. BOOTH.

(See also Vol. iii, part 4, January, 1911.)

DUPLEX working of the Baudot system continues to yield the excellent results that were obtained from the sets installed at the Central Telegraph Office in 1910.

The quadruple duplex on the underground loop circuit between London and Birmingham gives a uniform daily output of some 3600 messages in twelve hours, including the slack hours of the early morning and late evening. Occasionally the daily total has exceeded 4000, while on the day following the fire at the test-box of the Central Telegraph Office, London, in August, 1912, the following results were obtained between 10 a.m. and 5 p.m.:

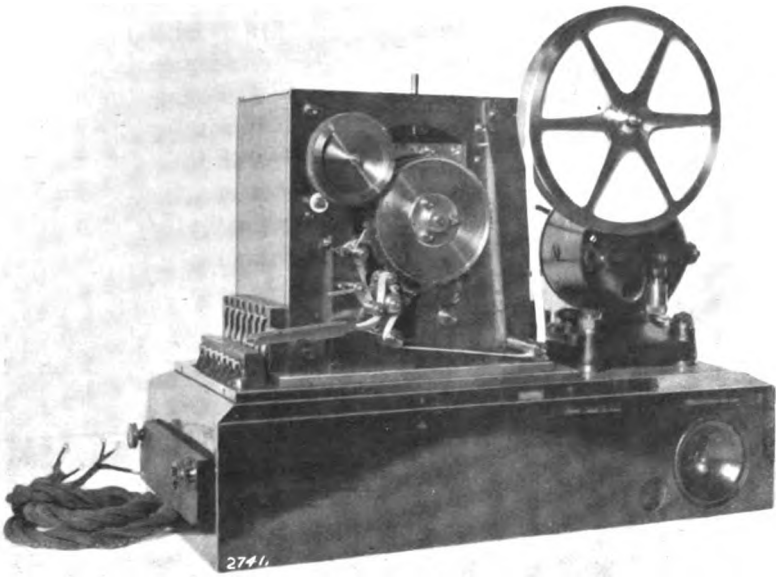
| | |
|---|---|
| 10–11 a.m. = 595 messages | Average of 550 messages per hour. |
| 11–12 a.m. = 576 ,, | ,, 68·75 ,, per channel. |
| 12– 1 p.m. = 551 ,, | Total of 3851 in 7 hours. |
| 1– 2 p.m. = 579 ,, | ,, 5025 in 12 ,, |
| 2– 3 p.m. = 516 ,, | |
| 3– 4 p.m. = 501 ,, | |
| 4– 5 p.m. = 533 ,, | |

The hourly output obtained confirms my estimate given in the paper on the Baudot printing telegraph system before the Institution of Post Office Electrical Engineers in March, 1907, viz. 400 to 600 messages per hour, showing that the expectations were not so "fanciful" as was alleged at that time.

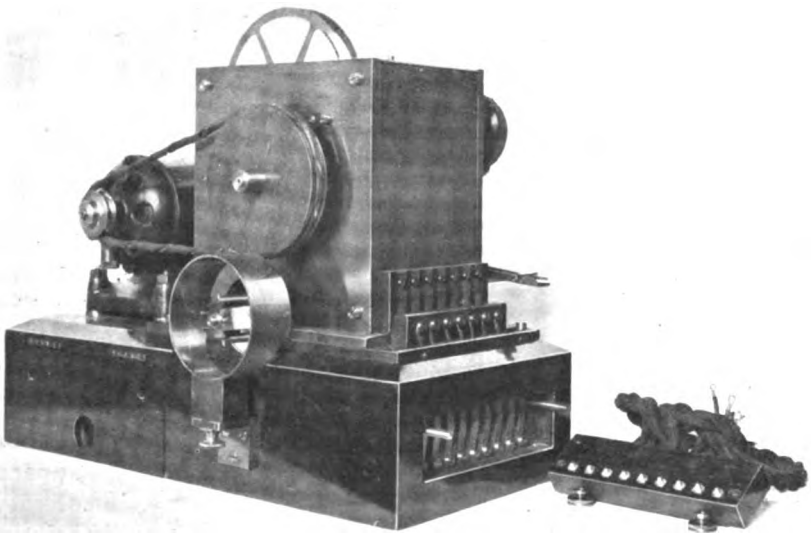
The consistently good daily output obtained from this set for nearly three years, without a stand-by set at either end, has induced the Post Office authorities to equip three more inland circuits with



Digitized by Google




**1.**—MOTOR-DRIVEN BAUDOT RECEIVER. FRONT VIEW.



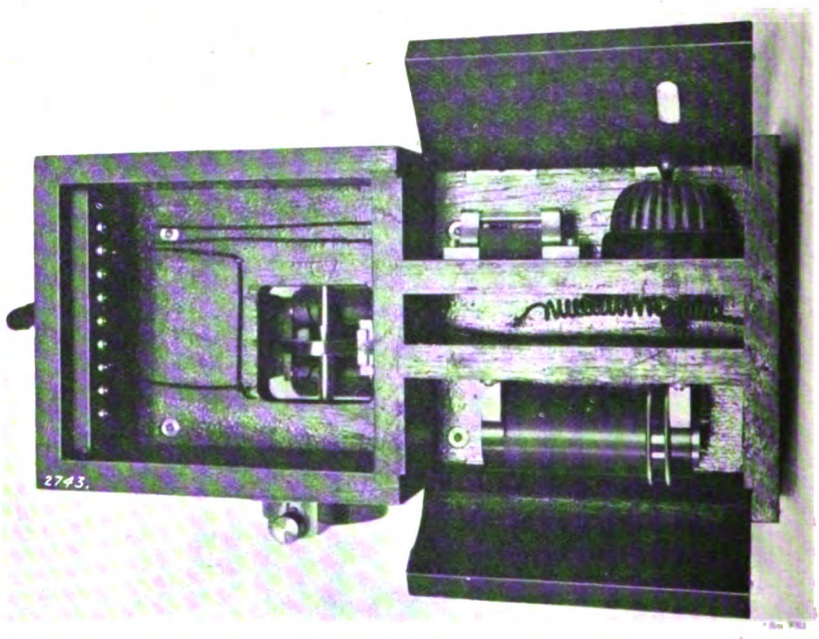
**2.** — MOTOR-DRIVEN BAUDOT RECEIVER. BACK VIEW, SHOWING SPRING CONNECTION TABLET ON SIDE.



Digitized by Google

quadruple duplex apparatus, modified somewhat from the double plate quadruple set that was altered to provide the experimental set.

The new quadruple duplex sets are fitted with motor-driven receivers, 1, 2 and 3, having tablet connections for readily changing the entire receiver whenever necessary. Although the motor is adapted for 110 volts it is worked with 40 volts, and is provided with an adjustable resistance placed in the base of the instrument for varying the speed within small limits, after it has been suitably set by means of the friction-governor known as the " Moderator."




3.— Base of Motor-driven Baudot Receiver, as Viewed from Below.

The keyboard has been modified as shown in 4 and 5. A tablet connection has been fitted for easy and quick replacement purposes, and also a contact bar for automatically joining the spacing battery to the five distributor segments when a keyboard is being changed, so that the duplex balance at the distant station shall not be disturbed for more than a second or two during the changing operations. The set is always at duplex; a switch therefore is unnecessary on the keyboard; this lessens the amount of wiring and also the possibility of faults. The contact points have been made adjustable independently, and are entirely enclosed when the hinged cover is down. For cleaning purposes the bars carrying the contact screws

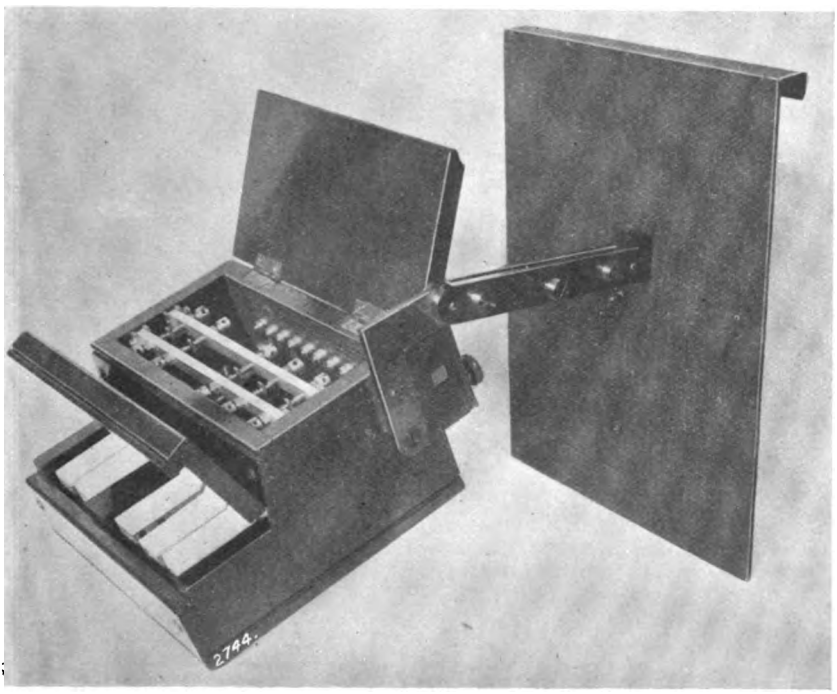


Digitized by Google

have slotted ends, and have been arranged to slide friction-tight into slots, where they can be locked by screws.

The distributor is arranged with one relay only for reception, repeating directly into the shortened segments to which the receiver magnets are connected. As no propagation segments are required, the distributor plate is divided into twenty-two segments, as against twenty-four on the ordinary quadruple simplex set.

During the period of nearly four years that the sets have been working, not more than six serious stoppages have occurred; hence,




**4.**—BAUDOT KEYBOARD, SHOWING INTERIOR.

it does not appear necessary at present to provide two distributors at each end. On this account the sending plate is attached to the rear of the distributor in the usual way.

**6** shows the distributor-plate, which is the same in construction for front and back with the exception of the movable contact; *A* being for front plate reception, *C* for back plate sending with the numbering of the segments in the reverse order to *A*; whilst *B* is for back plate reception should such be required, as in the combined double and triple duplex sets with two distributors.

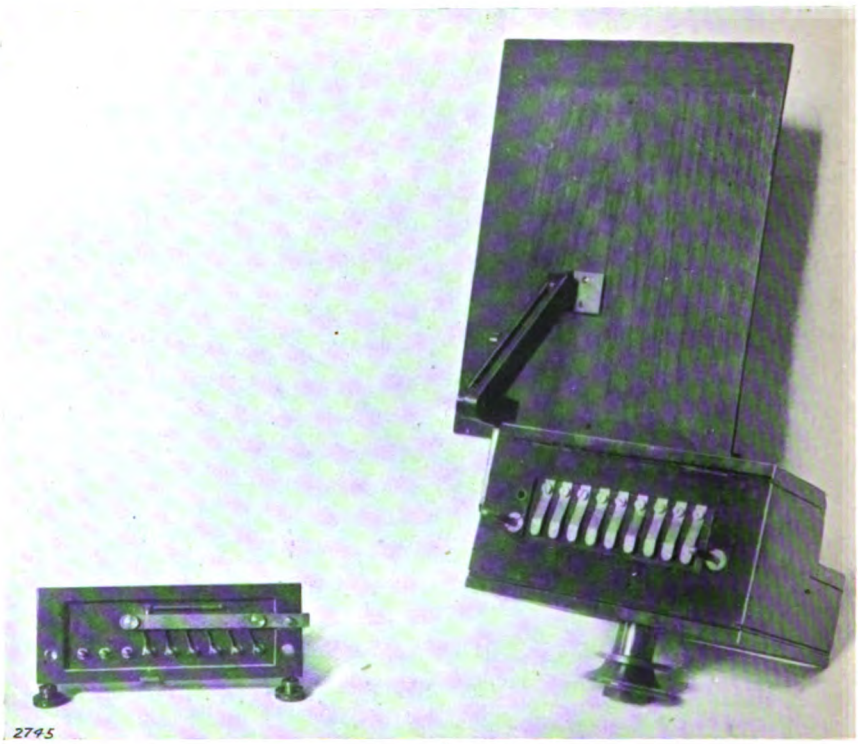
**7** shows the connections in the test-box on the distributor table.



Digitized by Google

In accordance with general practice the keyboards are connected to the two lower bars, and although a ten-wire cable is provided actually only nine wires are required, as the connection to the relay that is needed on a simplex set is not necessary on a duplex set. The tenth wire thus forms a convenient spare in case of a fault developing in one of the keyboard or receiver cables.

8 shows the main connections of the set, from which the paths of the outgoing and incoming currents can be traced by refer-



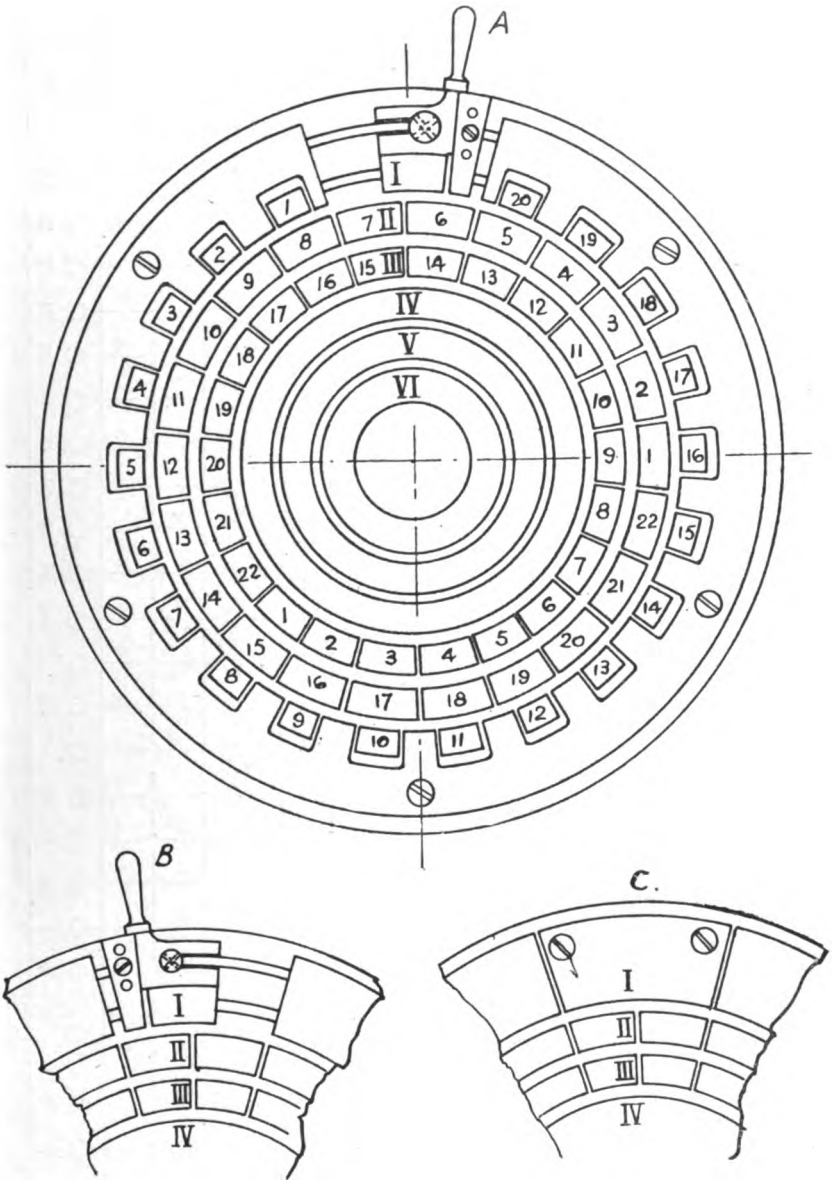

5.—Baudot Keyboard, showing Connection Tablet Removed.

ence to the skeleton diagram in 9. A spare "line" relay is provided for immediate change-over purposes by means of the 9-terminal switch shown on the relay tray. Of the other switches shown, one is for turning to Morse, another is for replacing the battery by a resistance for balancing purposes, while the third is for checking the incoming or outgoing signals on a Wheatstone-Morse receiver joined through a resistance to either the "Line" or "Leak" relay as required.

10 shows a plan of the apparatus on the distributor table. It will be seen that three of the switches are placed vertically in order to provide sufficient writing space.



Digitized by Google

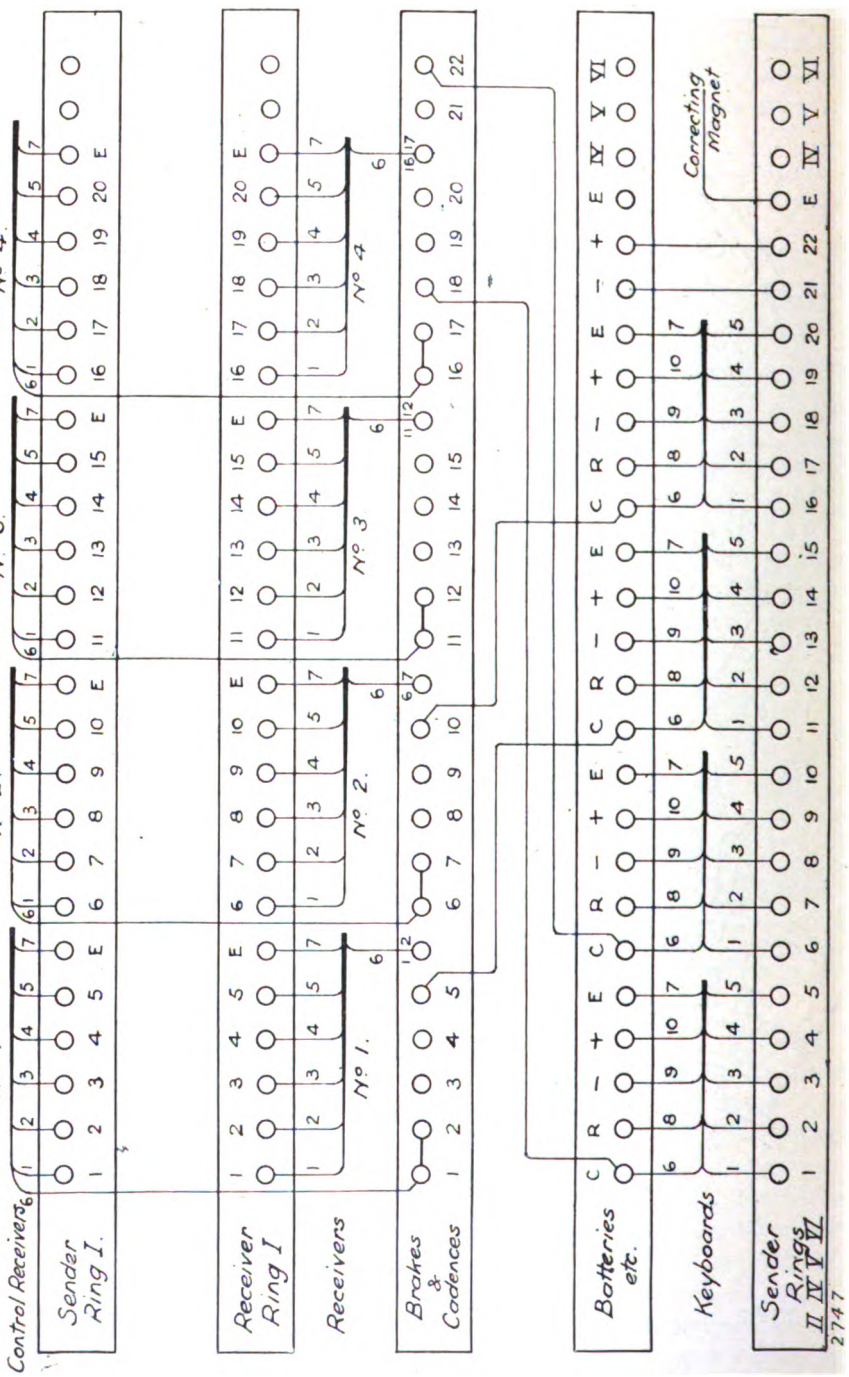



A. Moveable contact with fork - left hand.
B. " " " " - right hand.
2746 C. With fixed block

6.—Baudot Distributor Plate (22 Segments).



Digitized by Google




7.—Connections in the Test-box on the Distributor Table.



Digitized by Google

The setting of the brushes is a simple matter, as there need be no particular relation between the sending and receiving brushes at the corrected station. It is convenient, however, to set both the sending and receiving brushes on the centre of their No. 1 segments, and then to allow the correcting station to find his position by altering the brush-driving ring if necessary, in order to bring his front plate to a suitable position without undue strain on the connecting cable.

On comparatively short circuits the time of propagation of a signal over a line is small; but on the long circuits with one or more repeaters, such as on the London–Berlin double duplex circuits, the propagation time ranges up to 4 segments or 120 degrees, *i. e.* about one ninth of a second, and varies some 60 degrees, apparently in accordance with the way in which the relays and repeaters are adjusted.*

There are now four double duplex sets working between London and Berlin through the wires in the same 4-core submarine cable, which is approximately 300 miles in length.

It is interesting to compare the traffic carried by the duplex double Baudot sets and the duplex Hughes sets which worked on similar circuits through the same submarine cable.

So far as I can ascertain, the best results from the duplex Hughes were on the Berlin Bourse circuit, where in February, 1909, a total for one hour of 170 messages was obtained, of which London sent 90 and Berlin 80. The next highest figure is 156; a total of 140 messages in one hour has been obtained a number of times.

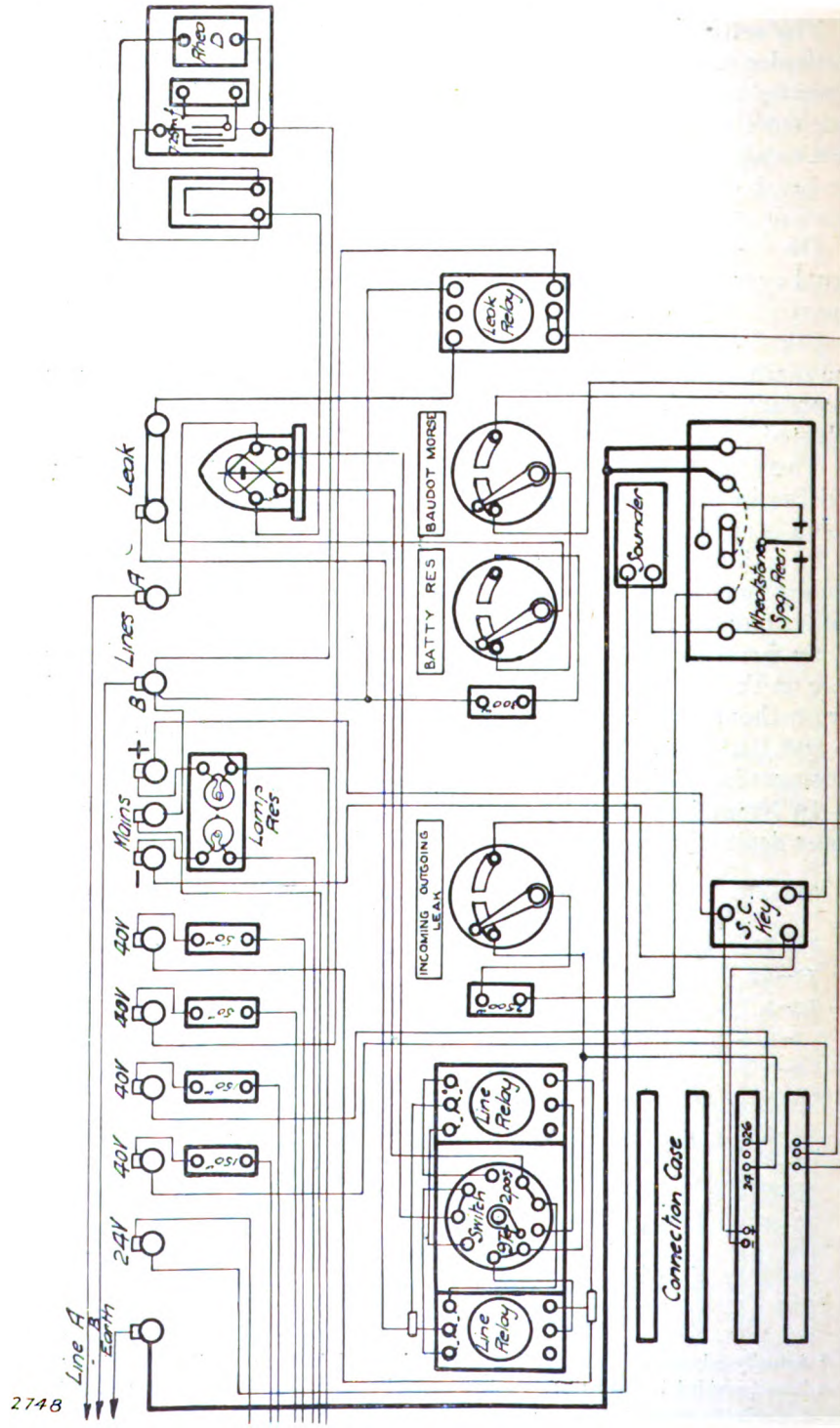
In November, 1911, the duplex double Baudot for ten consecutive hours dealt with the following numbers of messages:

| Time. | Sender. | | Receiver. | | Total. |
|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | |
| 10–11 | 50 | 40 | 60 | 47 | 197 |
| 11–12 | 80 | 70 | 70 | 63 | 283 |
| 12–1 | 62 | 85 | 61 | 70 | 278 |
| 1–2 | 71 | 62 | 55 | 50 | 238 |
| 2–3 | 53 | 70 | 45 | 40 | 208 |
| 3–4 | 62 | 46 | 47 | 71 | 226 |
| 4–5 | 65 | 75 | 47 | 49 | 236 |
| 5–6 | 70 | 60 | 63 | 52 | 245 |
| 6–7 | 44 | 26 | 50 | 28 | 148 |
| 7–8 | 49 | 47 | 55 | 50 | 201 |
| | 606 | 581 | 553 | 520 | 2260 |
| | 1187 | | 1073 | | |

* Actually only seventeen segments are required for triple duplex working, but eighteen have been provided in order that complete alternations (reversals) may be sent over the line to enable the repeater stations to adjust their apparatus correctly.



Digitized by Google



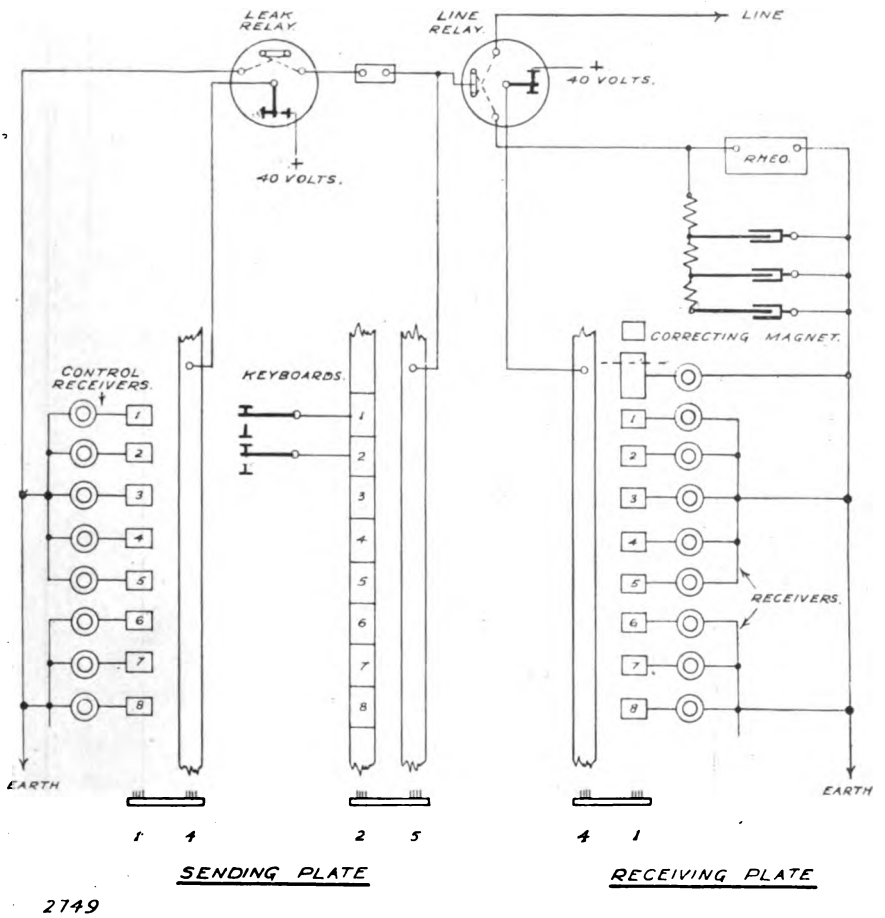

8.—Baudot Quadruple Duplex. Circuit Connections.



Digitized by Google

Although the foregoing record is the best obtained, there have been many other occasions when the output in an hour considerably exceeded 200 messages. Now that two such circuits exist there is not sufficient traffic to fill either set.

Several of the new sets will be equipped with two distributors,

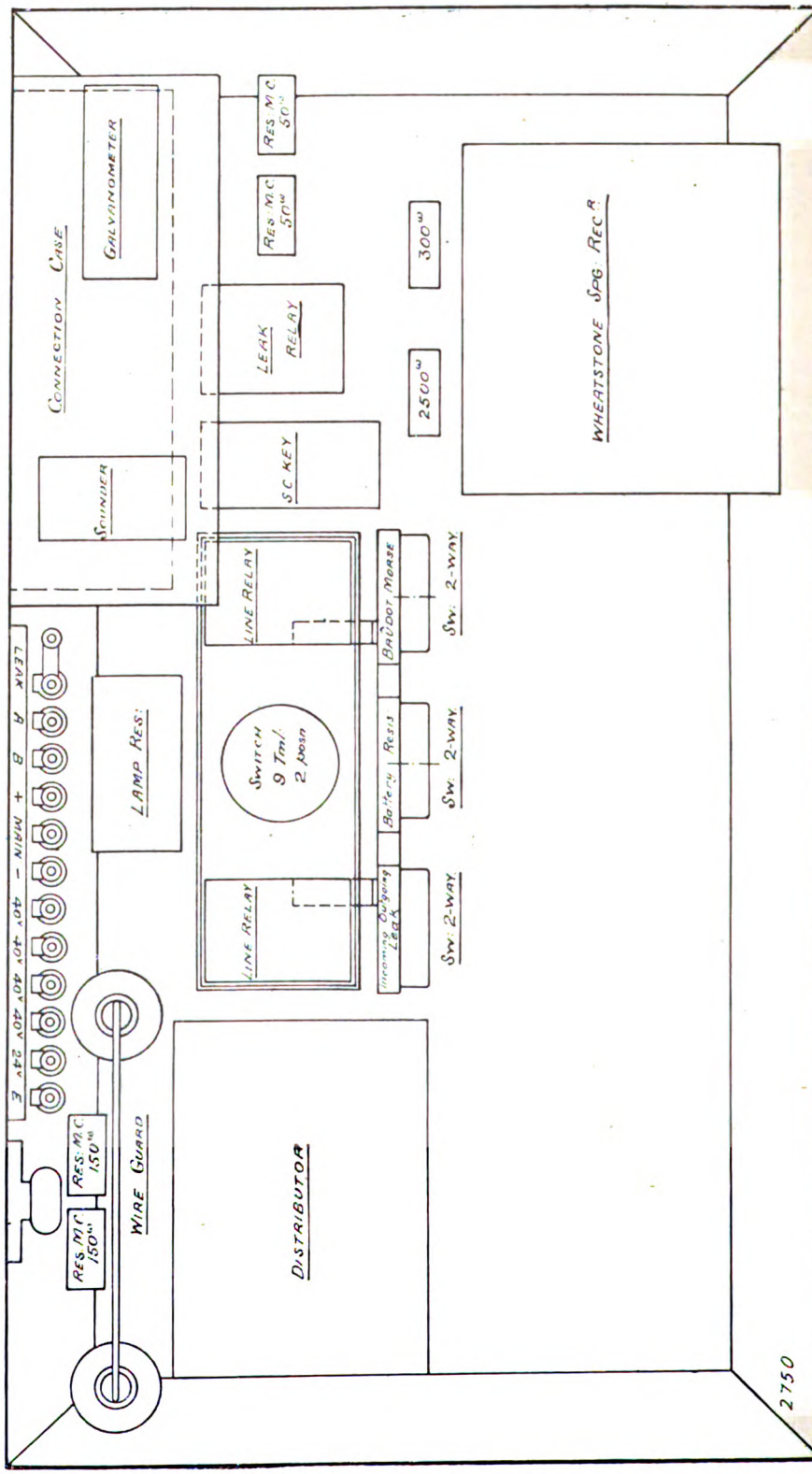



9.—Baudot Duplex (Skeleton Diagram of Connections).

each of which will be fitted with eighteen segment plates for triple duplex working on the front, and twelve segment plates on the back for double duplex working, it being merely necessary to shift the brushes from the front and to put others on the back to change from triple duplex to double duplex. The arrangement will also permit of triple duplex working in one direction, while the other may be working double duplex. The connections and arrangements for



Digitized by Google



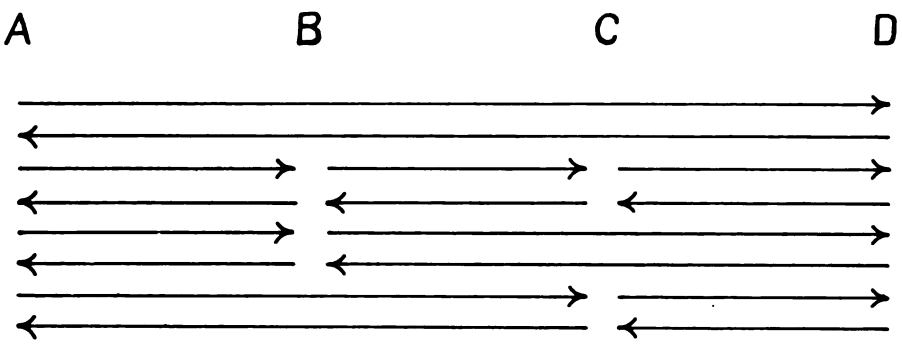

**10.**—Baudot Duplex. Arrangement of Apparatus on Distributor Table.



Digitized by Google

these combined sets are the same in principle as for the quadruple duplex sets just described.

It will be obvious that, although only Differential duplex has so far been employed, the Bridge duplex arrangement or the Gulstad Relay device can readily be provided for. Up to the present the simpler differential duplex arrangement has been sufficient for the length and type of circuits on which Baudot duplex has so far been fitted, but in order to avoid the introduction of a Duplex Repeater




Four stations on one circuit giving:-

A to B 60 words per minute in each direction.
A to C 30 " " " " " "
A to D 30 " " " " " "
B to C 30 " " " " " "
B to D 30 " " " " " "
C to D 60 " " " " " "

2751 Fig 11.

on the longer lines it may prove advantageous to adopt more delicate arrangements of relays, etc., for reception at the terminal stations.

Owing to the want of apparatus it has not been possible up to the present to attempt anything in the direction of omnibus circuit working with the duplex Baudot, but it is obvious that with eight or more channels on one circuit this most useful application of the Baudot system can be extended much more easily than has so far been the case with simplex sets. Apart altogether from the additional channels available, the extensions and the correcting arrangements will be simplified, and much less difficulty will be experienced in maintaining correct speeds.

By thus linking up four offices on one circuit to provide direct communication, each with each (11), the present somewhat costly arrangements of pasting-up Wheatstone-Morse slip and re-perforating for re-transmission at those intermediate points, with the unavoidable



Digitized by Google

delay entailed in the process, will be eliminated. Even the proposal to use receiving perforators at the intermediate points entails the sorting out of the perforated slip, the conveyance to the forwarding circuit, the clerks' services, and the necessary time for the various operations.

All these disadvantages are avoided on the omnibus Baudot circuit, whether simplex or duplex, and it is a matter for regret that sufficient apparatus is not yet available to show what can be done in this direction.

Within the next twelve months there will be two more offices gaining the required experience, and it should, therefore, be possible to commence omnibus working with the duplex Baudot in about two years hence if sufficient apparatus can be made available in the meantime.

A circuit with quadruple duplex Baudot apparatus linking up four stations (11) may seem a rather formidable arrangement, and one likely to be out of order frequently, but on such a circuit working through the underground cable where balances are practically fixed, serious difficulty can only arise when the line or a distributor gets out of order. Such faults do occur, but at very infrequent intervals, as is proved by the working of the London-Birmingham Baudot circuit during a period of nearly four years. Keyboards and receivers can be changed in a few seconds, but more time is required at present to change a distributor. Improvement in this direction is already receiving attention.

Should such a fault arise, it would stop communication in the particular section concerned, but would permit working to continue on the other sections, where full use can be made of the eight channels. This feature makes the arrangement very useful for sudden increases of traffic between any two points, as any or all of the channels can be terminated or extended at any of the intermediate points by merely turning a switch.

The sextuple duplex apparatus is ready for trial, and will be equipped on a working circuit between London and Birmingham by the time this article appears.

---

## SECONDARY CELL MAINTENANCE.

### The Importance of Hydrometer Readings.

If the electro-motive force of a secondary cell which has been lying idle for a long period, even after it has been discharged, be measured with the usual high-resistance voltmeter the instrument will indicate 2 volts.

On the other hand, if a secondary cell from which the rated

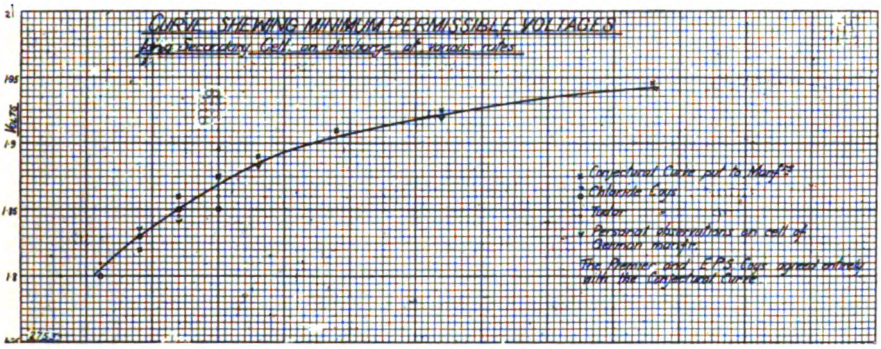


Digitized by Google

ampère-hour capacity has been taken be measured whilst a current is flowing equal to one-ninth the rated ampère-hour capacity, the voltage across the cell terminals will read 1·82 volts, or thereabouts, provided the cell is in good condition.

Now, if the current be increased, say, to three times the last value, the voltmeter will show something less than 1·82—probably about 1·75. By decreasing the discharge current, say, to one third the original value, the voltage will rise, and after a few minutes will reach a value of over 1·9 volts. The curve (1) shows the actual value which obtains in practice with cells in perfect order.

Suppose, however, the cell under observation happened to have lost a portion of its capacity for some reason or other, and, as is generally the case, the amount lost was unknown, how do the voltmeter tests stand? On open circuit the reading would be 2 volts.




1.

A discharge rate of one-ninth the *rated* capacity would now be equal to a higher *effective* rate. If, for instance, the cell had lost 50 per cent. capacity it would be equal to a two-ninths rate, and the voltage limit would not be the voltage at the one-ninth rate, viz. 1·82 volts, but a lower value.

It is known that if only a portion of the capacity of a cell be regularly drawn upon, the capacity not used will be permanently lost. Therefore, if a cell which has lost capacity be recharged each time the voltage reaches 1·82 volts at a fixed current discharge rate, special remedial steps will have to be taken by way of excessive overcharging, otherwise the loss will increase charge by charge.

The secondary cells used for telegraph and telephone purposes are subject to discharge rates which vary greatly. Seldom are such cells called upon to discharge at heavy rates, and certainly it is only by accident that one may see a set discharging at a rate which approximates to one ninth the capacity. As methods now stand, we cannot be certain of the effective ampère-hour capacity of cells used



Digitized by Google

for telegraphs or telephones after two or three years' work, and one is driven to the conclusion that voltmeter tests form a very unsatisfactory and unreliable means of gauging the condition of secondary cells on discharge. In other words, there is no guarantee when the voltmeter shows from 1·82 to 2 volts per cell that the battery is safe. Even with the voltmeter showing 2 volts per cell it is possible that a heavy discharge for a short period may cause the battery to collapse. Then the voltmeter will show it—too late. A voltmeter and an ammeter are necessary, in order to give exact information as to what a battery may be doing from moment to moment, and for various purposes affecting adjustment of power, for charging, resistance measurements, etc.

It can readily be shown from fundamentals that, for practical purposes with any lead—lead peroxide secondary cell, the number of ampère-hours discharged will be—

$$A = \frac{CG\ (G - G_1)}{\cdot 345 - \cdot 183\ G_1} \quad . \quad . \quad . \quad . \quad (1)$$

Where $A$ = (total) ampère-hours discharged;
$C$ = the volume of electrolyte in cubic inches;
$G$ = specific gravity at the beginning of a discharge;
$G_1$ = specific gravity at the end of a discharge;

or when the range of specific gravity lies anywhere between 1·170° and 1·210°.

$$A = \cdot 00924\ CR \text{ approximately} \quad . \quad . \quad (2)$$

Where $R$ = the total range in degrees (·001° $Sp.\ g. = 1$) of specific gravity moved through during a discharge.

From the formulæ it is clear that the normal range of change in specific gravity is, for all practical purposes, inversely proportional to the amount of the electrolyte in a secondary cell. Hence the reason, with perfect cells, for the slight variations sometimes observed in range of specific gravity in different cells of a battery and for different batteries, and if the information to be obtained is to be made use of, the necessity for maintaining a constant level of the electrolyte.

But the fact of greatest importance is that the number of ampère-hours obtained from each cell is practically proportional to the range of specific gravity moved through during a discharge.

The application of this principle is simple. Assume that the makers specify that the capacity of a battery be 400 ampère-hours, and it be found, either by volumetric* measurement of the electrolyte,

* The volume of the electrolyte may be taken to be:
Internal dimensions of tank to level of electrolyte, less—
Volume of plates + glass supports + displacement tank + solid sediment.
The volume of the positive and negative plates and separators in the various types of cells may be obtained from the following table:



Digitized by Google

or by a test discharge, that the specific gravity changes from 1·210 to 1·170, *i. e.* 40°. The average discharge will be $\frac{400}{40} = 10$ ampère-hours per degree. Therefore, when the specific gravity stood at 1·200, a change of 10°, which corresponds approximately to 10 × 10 = 100 ampère-hours, will have been obtained, and 300 ampère-hours will remain. A more exact value may be deduced by using the extended formula (1), which will show that actually 104 ampère-hours were obtained with the change of specific gravity from 1·210 to 1·200, C having a value of 1083 cubic inches, as may be deduced from (2).

Secondary cells do not break down suddenly except, of course, in case of accident, and there are, therefore, reasonable grounds for assuming that the range of specific gravity which the cell will move through will at least correspond to that which it moved through on the last discharge, if of reasonably recent date. Clearly, then, without having resort to ampère-hour meters, one has a reliable means of ascertaining not only what work a cell has done, but also, what is often more important information, the amount of additional work it may be expected to do; for example, whether it may be relied upon to carry the exchange load overnight.

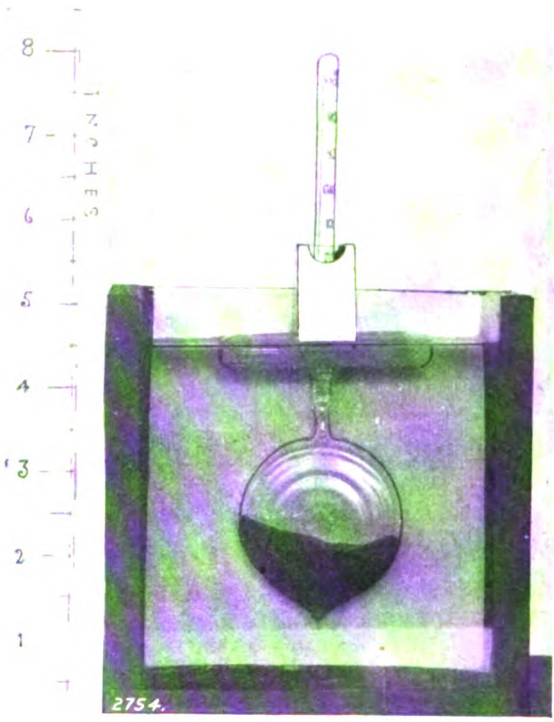
The usual means of measuring specific gravity of secondary cells is by hydrometer. Unfortunately for the welfare of existing secondary cells generally, the importance of the use of these instruments has not hitherto been appreciated as it deserves. Most of the hydrometers at present in use will only indicate changes of specific gravity of 5°. There are others which are divided into 1° units, but the divisions are so close together, and the stem and scale so slight,

| Maker and type of cell. | Total volume of negative and positive plates and separators in cubic inches ($x$ = No. of positive plates). |
|---|---|
| Chloride . { S Type | $75x + 25$ |
| Chloride . { C ,, | $230x + 80$ |
| E.P.S. . { D.H. ,, | $98x + 35$ |
| E.P.S. . { P. ,, | $150x + 60$ |
| E.P.S. . { O.M. ,, | $260x + 108$ |
| Tudor . { I ,, | $42x + 14$ |
| Tudor . { P ,, | $70x + 27$ |
| Tudor . { Q ,, | $130x + 50$ |
| Tudor . { R ,, | $260x + 50$ |
| Premier . { Small | $70x + 28$ |
| Premier . { Large | $80x + 32$ |
| D.P. . . { T ,, | $30x + 10$ |
| D.P. . . { L ,, | $75x + 27$ |
| D.P. . . { L.S ,, | $170x + 60$ |



Digitized by Google

that it is practically impossible to read accurately to two or three degrees. The difficulty is seriously accentuated by the fact that with all these instruments the reading must be taken at the surface of the electrolyte, and as the liquid rises up the stem of the hydrometer the true level of the electrolyte is indeterminable. The difficulty is a general one. When a hydrometer is designed for use in a clear solution contained in a glass vessel, the instrument is calibrated to be read through the side of the vessel. For use




2.—Hydrometer with Floating Index. 1·170° to 1·220° Sp. G.

in a liquid contained in an opaque vessel the calibration is such that the reading must be taken from above. Again, the usual type of hydrometer is suitable only for a deep secondary cell on account of the length of the buoyancy chamber. It cannot, therefore, be used in the small secondary cells serving many telegraph and telephone systems. These hydrometers will not remain steadily in position in the electrolyte, their movements being most tantalising when one desires to read quickly.

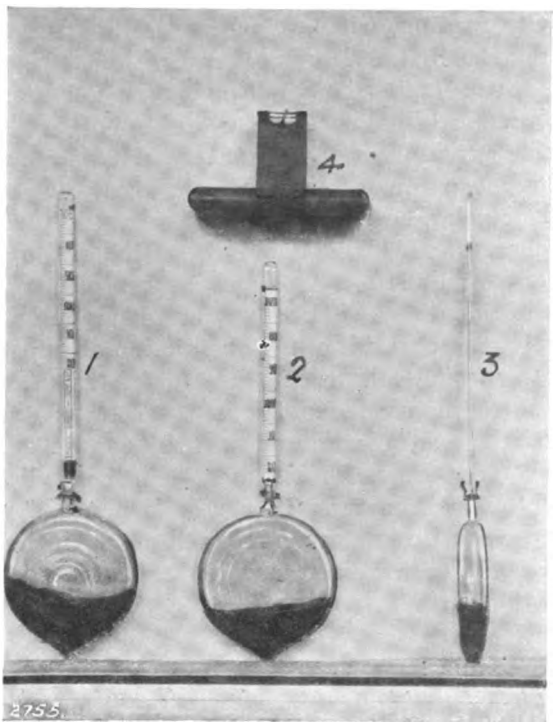
In order to obviate these difficulties a new type of hydrometer has recently been designed, and a number has been brought into use



Digitized by Google

by the Department. It is shown floating in a glass-sided tank in **2**, whilst three hydrometers and a floating curser are shown in **3**.

The hydrometer consists of a flat scaled stem and a flat circular buoyancy chamber. The stem passes through the small float, and the scale is read 1½ inches above the surface of the liquid by means of a curser line carried by the float, as is shown clearly in **2**. Thus, in a secondary cell, the reading, accurate to ·0005° specific gravity, is easily and quickly read slightly above the level of the tank. The




**3.**—1 and 3, Front and Side Views of 7-in. Hydrometer. 2, 6-in. Hydrometer. 4, Floating Index used with Hydrometers 1 and 3.

float keeps the hydrometer away from the sides of the plate and tank, with the full scale details always facing the observer. The shape of the buoyancy chamber permits of shallow floatage.

The maker of the new hydrometer is Mr. Thomas O. Blake, Hatton Garden.

The use of the new instrument soon brings to light the importance of regarding the effect of temperature variations upon specific gravity readings of the electrolyte. Hydrometer readings are correct at 60° F. For temperatures higher than 60° Fahr., 1° Sp. G. (·001°)



Digitized by Google

must be added for each 3° rise in temperature above 60°, and 1° Sp. G. deducted for each 3° less than 60° Fahr.

The earlier portion of this article deals mainly with the conditions which obtain during a discharge of a secondary cell, but the formulæ (1) and (2) apply also to charging; but in that case it must be remembered that, throughout the charge, the specific gravity of the electrolyte fails to rise for a time at the commencement of the charge, and then lags behind throughout the charge, only reaching its maximum value about fifteen minutes after the charging current has been disconnected. If a secondary cell is in perfect order the specific gravity readings will be consistent. Short circuits, due to paste or extraneous matter lodging between the plates, or sediment touching the bottom of the plates, will result in inconsistent behaviour. It makes no practical difference in the working of a cell whether the highest specific gravity be·1·215 or 1·205, and it is a waste of time to attempt to always maintain either the one value or the other. There should be, however, no abrupt changes in the maxima for consecutive charges. If there be a marked fall in the highest specific gravity readings "sulphation" may have taken place.

In course of time there will be a gradual reduction in the strength of the electrolyte as a result of the abstraction of sulphuric acid by the solid matter which falls to the bottom of the cell, and if this sediment be stirred up a sudden fall in the specific gravity may be observed. Partial neutralisation of the acid by an alkali—ammonia gas from Leclanché cells, for instance—will be indicated by the behaviour of the hydrometer. In fact it is doubtful whether any serious defect can arise in a secondary cell of which the hydrometer readings will not give warning, or which cannot be detected by an inspection of the cell. J. G. L.

---

## ALTERNATING CURRENT CALCULATIONS.

By F. Addey, B.Sc., A.M.I.E.E.

(*Continued from page* 195.)

We will now investigate a few bridge arrangements by means of this method.

With the arrangement for the measurement of capacity shown in 7, we have—

$$R_1 \times \frac{1}{K_2\theta} = R_2 \times \frac{1}{K_1\theta}.$$

Therefore—

$$R_1K_1\theta = R_2K_2\theta,$$



Digitized by Google

or—

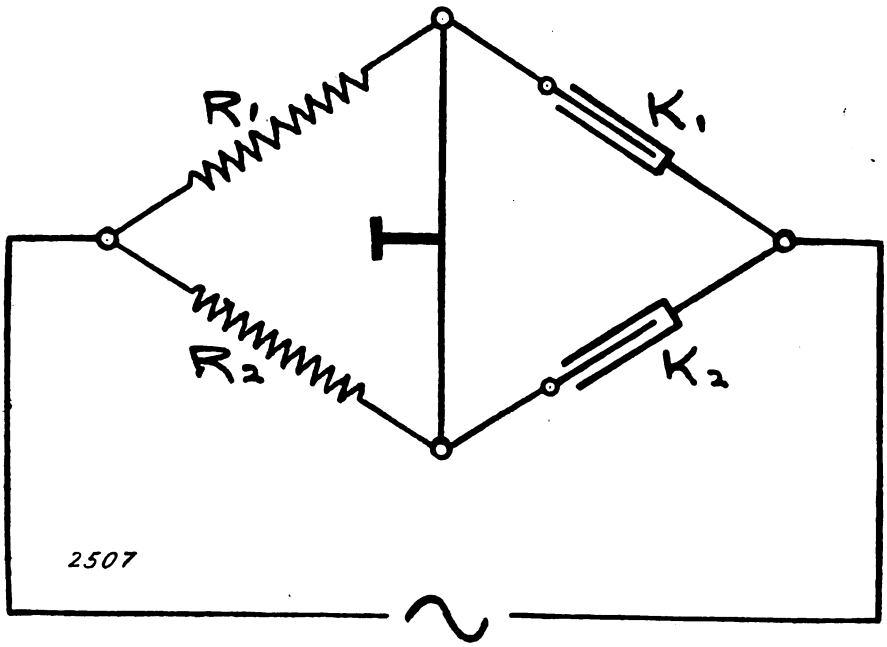
$$R_1K_1 = R_2K_2.$$

Thus, if $R_1$, $R_2$ and $K_1$ be known, and $K_2$ be unknown, we have—

$$K_2 = \frac{R_1}{R_2} K_1.$$

Since $w$ does not enter into this expression, the balance is independent of the frequency of the current used for making the test.

The arrangement shown in **8** is a method for the measurement of the resistance and inductance of a coil of wire. The impedance




**7.**—Bridge Measurement of Capacity.

operator of the upper left-hand arm of the bridge, which consists of a condenser in parallel with a non-inductive resistance, is obtained in exactly the same way as the combined resistances of two wires in parallel. The required impedance operator for this arm is—

$$\frac{r \times \frac{1}{k\theta}}{r + \frac{1}{k\theta}} = \frac{r}{1 + kr\theta}.$$

Therefore, when balance is obtained, we have—

$$PQ = (R + L\theta)\left(\frac{r}{1 + kr\theta}\right),$$

$$PQ + PQkr\theta = Rr + Lr\theta.$$



Digitized by Google

Hence the conditions for balance are that $PQ = Rr$, or the bridge must be balanced for steady currents, and also that $PQkr = Lr$.

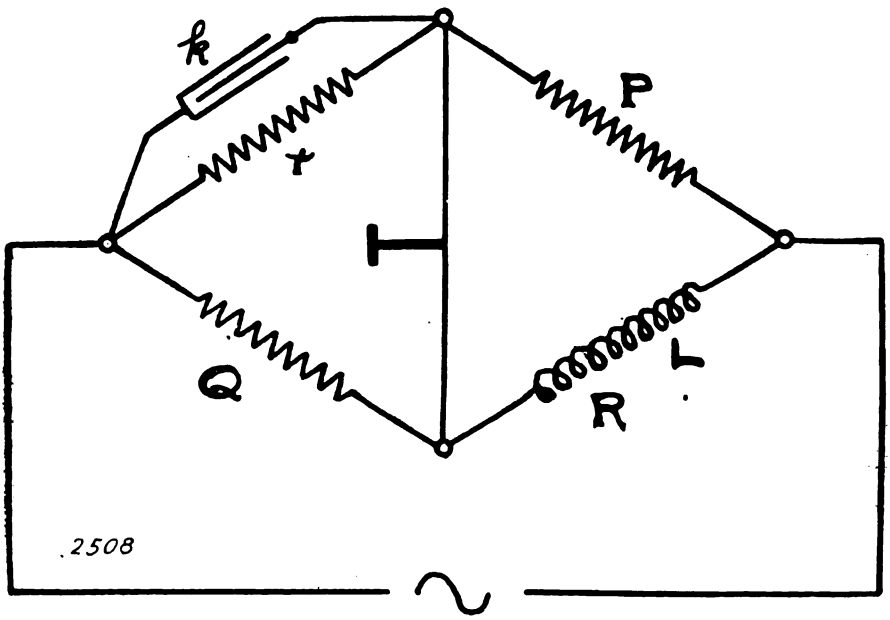
Hence we have—

$$R = \frac{PQ}{r},$$

and—

$$L = PQk.$$

In this case also it will be seen that balance is independent of the frequency.




8.—Bridge Measurement of Resistance and Inductance, using a Condenser shunted by a Resistance.

Another arrangement for the measurement of resistance and inductance is shown in 9. In this case we have—

$$PQ = (R + L\theta)\left(r + \frac{1}{k\theta}\right),$$

$$PQ = (R + L\theta)\left(\frac{1 + kr\theta}{k\theta}\right),$$

$$PQk\theta = R + (L + krR)\theta + krL\theta^2.$$

Therefore—

$$PQk\theta = (R - krLw^2) + (L + krR)\theta.$$

Equating co-efficients of like terms we have for the conditions of balance—

$$R - krLw^2 = O,$$

and—

$$PQk = L + krR.$$



Digitized by Google

Hence—

$$R = krw^2L,$$

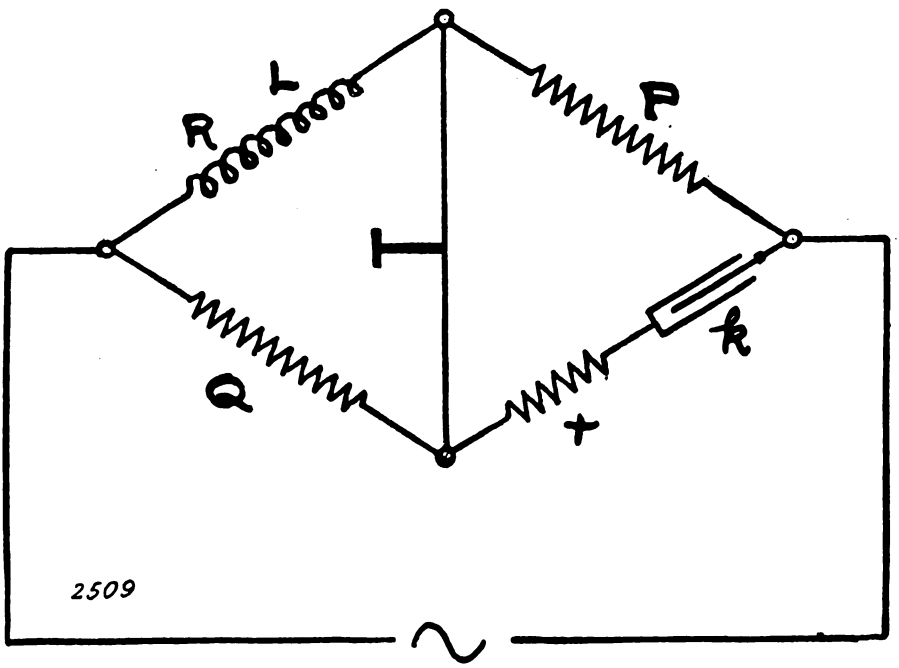
and substituting this value of $R$ in the second balance condition we have—

$$PQk = L + k^2r^2w^2L,$$

or—

$$L = \frac{PQk}{1 + k^2r^2w^2}.$$

In this case, since $w$ appears in the conditions of balance, the




9.—Bridge Measurement of Resistance and Inductance, using a Condenser in Series with a Resistance.

balance will only be correct for a definite frequency. This means that a pure sine wave current must be used. If a complex current wave were used, and the conditions for balance with the frequency of the fundamental wave obtained, these conditions would not be correct for the frequencies of the overtones present, and therefore silence could not be obtained on the telephone used to indicate balance.

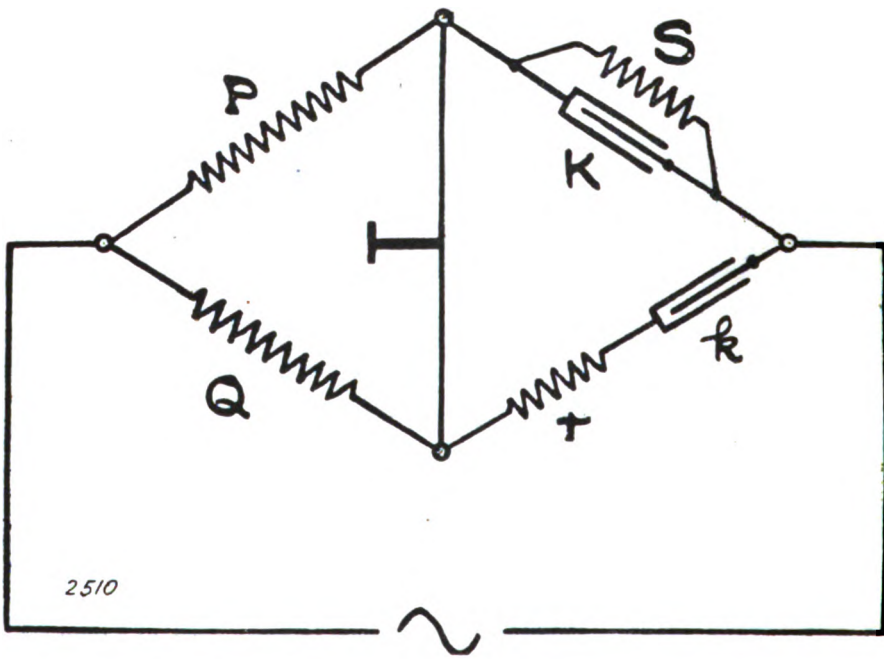
The last of the ordinary Wheatstone bridge arrangements which will be considered is that for the measurement of capacity and leakance shown in 10. The upper right-hand arm of the bridge represents a leaky condenser, or other capacity, as, for example, a telephone loop. Such a leaky condenser is equivalent to a condenser



Digitized by Google

with perfect insulation shunted with a resistance. Let $S$ be the value of the *conductance* of this equivalent shunt round the condenser. The resistance of the shunt will be $\frac{1}{S}$, and the impedance operator of this arm of the bridge will therefore be—

$$\frac{\frac{1}{S} \times \frac{1}{K\theta}}{\frac{1}{S} + \frac{1}{K\theta}} = \frac{1}{S + K\theta}.$$




10.—Bridge Measurement of Capacity and Leakance.

Hence—

$$P\left(r + \frac{1}{k\theta}\right) = Q\left(\frac{1}{S + K\theta}\right),$$

$$P\,(rk\theta + 1)\,(S + K\theta) = Qk\theta.$$

$$PS + (PSrk + PK)\theta + PKrk\theta^2 = Qk\theta.$$

Therefore—

$$(PS - PKrkw^2) + (PSrk + PK)\theta = Qk\theta.$$

Therefore the conditions of balance are that—

$$PS - PKrkw^2 = o,$$

and—

$$PSrk + PK = Qk.$$

From the first of these conditions we obtain—

$$S = Krkw^2,$$



Digitized by Google

and substituting this value for $S$ in the second balance condition we have—

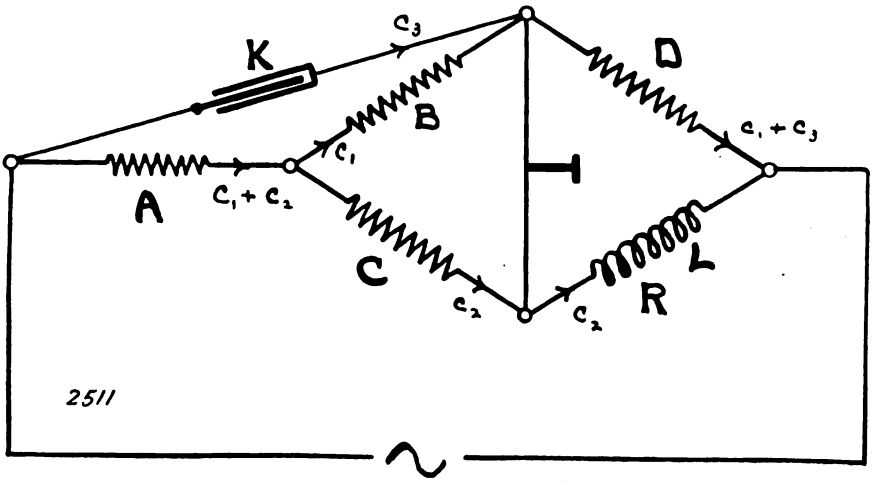
$$Pr^2k^2w^2K + PK = Qk.$$

Hence—

$$K = \frac{Qk}{P(r^2k^2w^2 + 1)}.$$

It will be seen that in this case, as in the previous one, the balance depends on the frequency of the testing current, which must therefore be a pure sine wave.

There are certain modifications of the ordinary Wheatstone bridge arrangement to which the rule given above for dealing with




II.—Anderson Bridge.

bridge problems is not applicable. The method of impedance operators is, however, of great use in the investigation of the theory of these methods.

We will here consider two such arrangements. The first is the Anderson method for the measurement of inductance and resistance. The connections for this method are shown in II.

The potential drop along the condenser branch $K$ is equal to that along the branches $A$ and $B$. Also, when balance is obtained, the potentials at each extremity of the telephone arm are the same. Hence the potential drop along the branch $B$ is equal to that along the branch $C$, and the drop along the branch $D$ is equal to that along the branch $R$.

Since there is no current through the telephone, the currents in the various branches will be as indicated on the diagram, and the following equations therefore hold good :



Digitized by Google

$$c_3 \frac{1}{K\theta} = (c_1 + c_2)\, A + c_1 B.$$

$$c_1 B = c_2 C,$$

$$(c_1 + c_3) D = c_2 (R + L\theta).$$

From the second of these equations we get $c_2 = c_1 \frac{B}{C}$, and substituting this value for $c_2$ in the first equation, we get—

$$c_3 = c_1 \left[\left(1 + \frac{B}{C}\right) A + B\right] K\theta.$$

Substituting the above values for $c_2$ and $c_3$ in the third equation, we get—

$$c_1 \left\{1 + \left[\left(1 + \frac{B}{C}\right) A + B\right] K\theta\right\} D = c_1 \frac{B}{C} (R + L\theta)$$

Therefore—

$$D + \left[\left(1 + \frac{B}{C}\right) A + B\right] DK\theta = \frac{BR}{C} + \frac{BL}{C}\theta.$$

Equating co-efficients of like terms, we get—

$$D = \frac{BR}{C},$$

and—

$$\left[\left(1 + \frac{B}{C}\right) A + B\right] DK = \frac{BL}{C}.$$

Hence—

$$R = \frac{CD}{B},$$

and—

$$L = \frac{CDK}{B}\left[\left(1 + \frac{B}{C}\right) A + B\right].$$

If $B = C$, we have

$$R = D,$$

and $L = DK\,(2A + B)$.

It will be seen that with this arrangement, balance is independent of the frequency of the testing current.

The second arrangement we will consider is the Campbell bridge for the measurement of resistance and inductance. The connections are shown in **12.**

The current is led to the bridge through one coil of a variable mutual inductance $M$, the other coil of which forms one arm of the bridge. Let $R^1$ and $L^1$ be the resistance and inductance of this second coil, $R$ and $L$ the resistance and inductance to be measured, and $P$ and $Q$ the resistance of the other arms of the bridge. When the bridge is balanced the currents will be distributed as shown on the diagram. The voltage drop along $R^1$ will be equal to that along $R$, and the drop along $P$ equal to that along $Q$. We have therefore the equations—



Digitized by Google

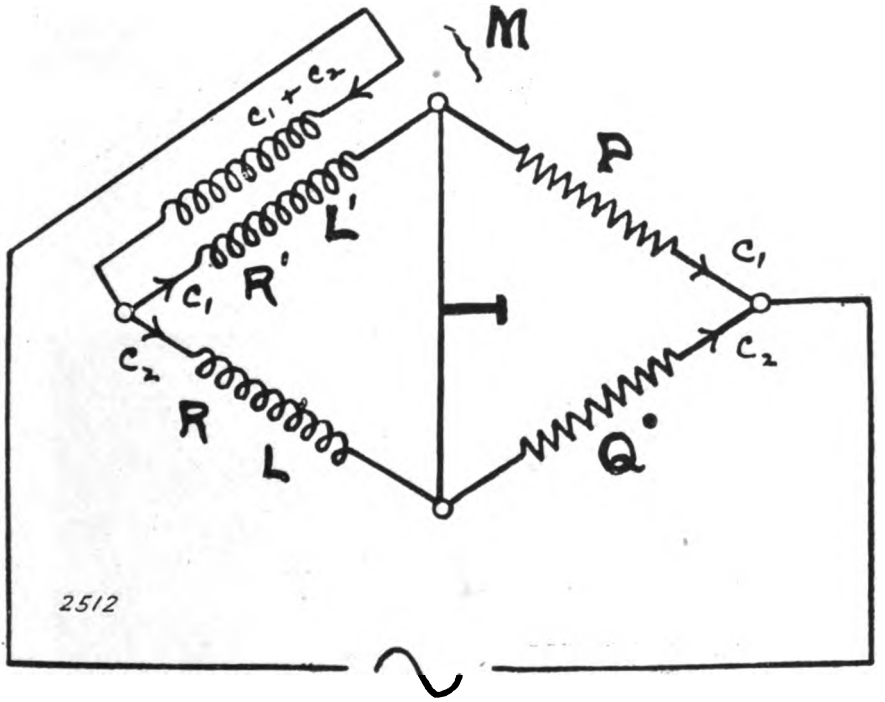
$$c_1(R^1 + L^1\theta) + M\theta(c_1 + c_2) = c_2(R + L\theta),$$

and—

$$c_1P = c_2Q.$$

Substituting for $c_2$ in the first equation in terms of $c_1$ from the second equation, we get—

$$c_1 (R^1 + L^1\theta) + M\theta c_1 \left(1 + \frac{P}{Q}\right) = c_1\frac{P}{Q} (R + L\theta).$$




12.—CAMPBELL BRIDGE.

Therefore—

$$R^1 + \left[L^1 + M\left(1 + \frac{P}{Q}\right)\right]\theta = \frac{PR}{Q} + \frac{PL}{Q}\theta.$$

Hence—

$$R^1 = \frac{PR}{Q},$$

and—

$$L^1 + M\left(1 + \frac{P}{Q}\right) = \frac{PL}{Q}$$

Therefore—

$$R = \frac{R^1Q}{P}.$$

and—



Digitized by Google

$$L = \frac{Q}{P} L^1 + \left(\frac{Q}{P} + 1\right) M.$$

If the arms $P$ and $Q$ be equal we have—

$$R^1 = R,$$

and—

$$L = L^1 + 2M.$$

It will be seen that this method is also independent of the frequency.

THE END.

THE LAST SCENE. DEMOLITION OF ROYAL EXCHANGE, GLASGOW.



Digitized by Google

# RE-ORGANISATION OF THE BRITISH COAST COMMUNICATION WIRELESS SERVICE.

By E. S. Perrin, B.Sc., A.M.Inst.C.E., and F. W. Davey.

The re-organisation scheme of the wireless coast stations undertaken to put the coast communication service upon a satisfactory basis allowed for the following:

Cullercoats.—To be purchased from the Poulsen Company.

North Foreland.—The power plant to be duplicated and the existing apparatus improved.

Niton.—A new station to be built to replace the existing one and the power to be increased from ¼ kw. to 1½ kw.

Lizard.—A new station to be built at St. Just to replace the Lizard, and the power to be increased from ¼ kw. to 5 kw.

Rosslare.—A new station to be built at Fishguard to replace the Rosslare station and the power to be 3 kw. instead of ¼ kw.

Malin Head.—A new station to be built to replace the existing one and the power to be increased from ¼ kw. to 5 kw.

Valencia.—A new 10 kw. station to be built on Valencia Island.

A musical note is provided for the last five stations, the spark frequencies being 300, 400, 300, 400 and 600, respectively in the order given.

Cullercoats.—The completion of the purchase of Cullercoats took place in March, 1912. The mast is 220 ft. high, of wood lattice construction, and the aërial of umbrella type. The transmitting apparatus is of the ordinary De Forest direct coupled type.

The power is taken from a public D.C. supply and feeds a motor alternator. The power normally used is about 2 kw. A Poulsen arc and some experimental plant were also included in the purchase of the station. Since the station has been taken over, the stays of



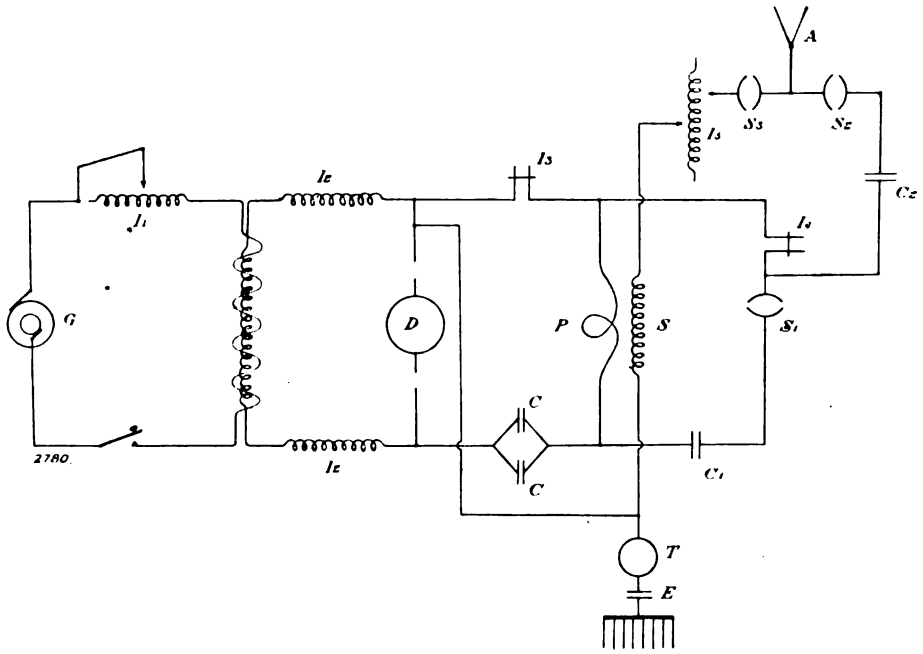
Digitized by Google

the mast have been entirely renewed. New anchorages have been made, and the station has been re-wired.

NORTH FORELAND.—The power for the station is taken from a public D.C. supply and feeds a motor alternator. The motor alternator has now been duplicated and the apparatus has been renewed.

FISHGUARD.—This is the first station that the Post Office has designed, and the installation of the wireless plant has been carried out by the Department.

The site was tested from a receiving point of view, by erecting




I.—FISHGUARD WIRELESS STATION.—SKELETON DIAGRAM OF CONNECTIONS.

two portable 70 ft. masts—one at Strumble Head and one at Fishguard—with suitable aërial and receiving gear. Messages were received from a boat going westwards from Fishguard. The object of this test was to determine whether there was any pronounced screening at Fishguard, but such was found not to be the case. An arrangement was therefore made with the Great Western Railway Company for a site on their property. The lay-out of the building was prepared by the Wireless Section, and the building plan got out by the Buildings Branch of the Secretary's Office, the building being put up by the Great Western Railway Company and rented to the Department.

The power is derived from the Great Western Railway Company's generating station. The system is three wire D.C. 440 volts



Digitized by Google

across the outers. The power is led to the switchboard, and from thence feeds a 3 kw. motor-alternator.

The skeleton diagram of connections is given in **1.**

The arrangement is similar to that installed at North Foreland, but the power used is greater.

$G$ is the alternator supplying power through an iron core choke, $I_1$, to the primary of a high-tension transformer. The secondary of the transformer is connected through two air core chokes to a rotary disc discharger, $D$. Round the disc discharger are formed two circuits, one tuned to a 600-metre wave consisting of the discharger $D$, condensers $C, C$, the primary of an oscillation transformer $P$, and an inductance $I_3$; the other (when the switch $S_1$ is closed), tuned to a 300-metre wave, consisting of the disc discharger $D$, condensers $C$, $C$ and $C_1$, and inductances $I_4$ and $I_3$. The 600-metre aërial circuit (operative when the switch $S_3$ is closed) is inductively coupled to the 600-metre closed circuit through the oscillation transformer $P.S.$ Included in the aërial circuit is a variable inductance, $I_5$, a thermo-ammeter $T$, and an earth arrester gap $E$.

The same aërial is used for 300 as for 600 metres, but in the former case direct coupling is adopted, $S_3$ is open and $S_2$ is closed, and the aërial is joined through a condenser $C_2$, and thence through $I_4$, $I_3$, $T$ and $E$ to earth. The connections between $S_1$ and the earth connection on $D$ are common to the primary and aërial systems.

The mathematical development of the theory of "The Low-frequency Circuit in Spark Telegraphy," by Mr. L. B. Turner, M.A., published in the 'Electrician,' August 2nd, 1912, was used as the basis for the design of the power plant and wireless plant. For the design of the station the capacity of the main condenser to be charged from the A.C. supply was fixed as ·065 mfd., the R.M.S. open-circuit voltage of the alternator at 300, and the periodicity at 150. There was to be one spark per half period attained by making the low-frequency system resonant—that is to say, the natural period of this system was made the same as the period of the applied E.M.F. In the design of an installation of this character the transformer can be considered as replaced by a capacity $\rho^2 C$ (where $\rho$ is the ratio of transformation and $C$ the capacity of the condenser in the secondary circuit of the transformer), and the resonant low-frequency circuit can be considered as equivalent to $G$, $I_2$ and $\rho^2 C$ in series. Resistance is negligible in comparison with other factors under the particular conditions, and the inductance of the transformer perforce does not enter into the calculation.

If $P$ = power (watts), $\rho$ = transformer ratio, $c$ = capacity, and $n$ = periodicity of supply,

$$P = nc\,(\rho v)^2$$

where $\rho v$ is the actual sparking $P.D.$



Digitized by Google

$$i.e.\ 3000 = 150\ \frac{\cdot 065}{10^6}\ (\rho v)^2$$

$$\therefore (\rho v)^2 = \frac{3000 \times 10^6}{150 \times \cdot 065}$$

$$= (17\cdot 5)^2 \times 10^6$$

$$\therefore \rho v = 17{,}500 \text{ volts.}$$

Assuming a simple sine wave form of the supply voltage and resonant conditions, then if $E$ is the peak voltage, the transformation ratio of the transformer is given by the formula—

$$\text{Sparking } P.D. = \frac{\pi}{2}\ \rho\ E$$

$$i.e.\ \frac{\pi\rho}{2}\ 300\ \sqrt{2} = 17{,}500,$$

$$\therefore \rho = \frac{17{,}500 \times \sqrt{2}}{\pi \times 300}$$

$$= 26\cdot 6 \text{ approximately.}$$

Hence the transformer was specified for ratio of—

300 to 7860 volts,

but insulated to carry the working load at 17,500 volts on the secondary.

The value of the inductance of the low-frequency circuit is calculated as follows:

$$L = \frac{E^2}{16\ n\ P}$$

$$= \frac{(300\sqrt{2})^2}{16 \times 150 \times 3000}$$

$$= \cdot 025 \text{ henry.}$$

The inductance of the armature was specified to be not greater than ·005 henry and a variable iron core choke of maximum value ·05 henry was fitted in the low-frequency circuit.

Referring to 1, the alternator $G$ delivers 3 kw. at a voltage which can be regulated between 200 and 400. The inductance of the armature does not exceed ·005 henry. The working frequency is 150. $I_1$ is an adjustable inductance fitted with ten stops; the maximum value is ·05 henry. The transformer has a ratio of 300 to 7860, but is insulated to withstand a working voltage of 17,500. $I_2$, $I_2$ are air core chokes to prevent the surgings from the high-frequency circuit getting back on to the low-frequency side. $D$ is a rotary disc discharge fitted with twelve studs. The rotary discharger consists of a disc fitted with as many studs as the alternator has poles. The disc rotates between two fixed discharging points so disposed that studs are opposite both discharging points at the same instant, and the constants of the apparatus and phase relationship of the discharger studs and alternator armature are so arranged that one discharge of the condenser occurs per half period. To enable this to be done the disc is bolted to the end of the alternator shaft,



Digitized by Google

but the bolts pass through radial slots so that the two are held together only by friction, and the disc can be moved relative to the armature of the alternator by slackening the bolts. The fixing of the disc relative to the armature is a very important point. It is essential that the instant of sparking should coincide with the instant of maximum charge in the condenser; if the discharge takes place too soon the condensers are not fully charged, and irregular sparking results; if the discharge takes place late the condensers are again not fully charged at the instant of sparking.

The few figures appended indicate how the power factor varies for small variations in the position of the disc and how critical the position is:

| Position of disc. | Power factor. |
|---|---|
| 20° | ·39 |
| 21·0° | ·47 |
| 22·0° | ·72 |
| 22·5° | ·68 |
| 23·9° | ·60 |
| 25·0° | ·56 |

30° on the disc represent the pole pitch.

The point indicated by position 25° is when the armature coils are directly under the poles.

As a matter of fact, at the peak of voltage of the alternator the moving stud should be two or three degrees behind the fixed stud.

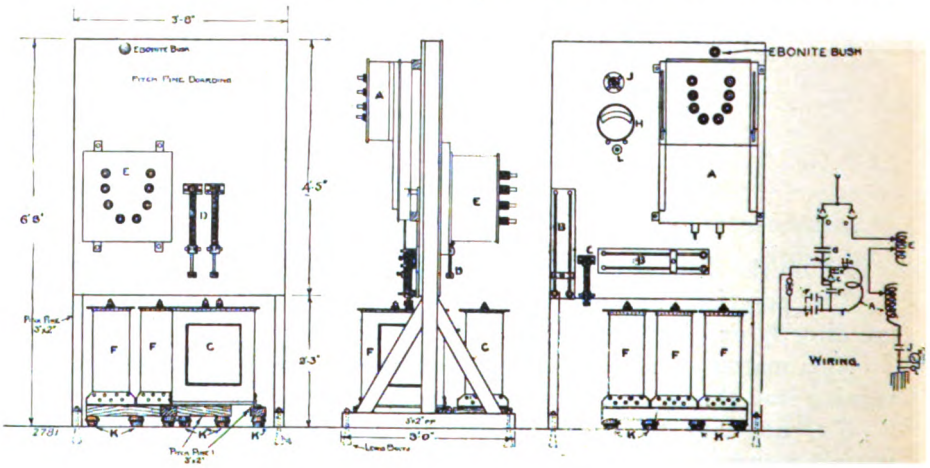
*C C* are each ·030 mfd. approximately. *P S* is an oscillation transformer for coupling the aërial to the primary circuit, and $I_3$ is a variable inductance for adjusting the wave length of the primary 600-metre circuit, and consists of two parallel brass bars about 15 inches long, with a sliding contact between them. The condensers are charged and discharged once every half period; if $S_3$ is closed and $S_2$ and $S_1$ open the 600-metre aërial circuit is coupled to the 600-metre primary circuit, $I_5$ being a variable inductance for adjusting the wave length of the former. Most of the adjustment was done on the aërial, so as to make $I_5$ practically nothing. The aërial thus oscillates as near as possible on its fundamental. *T* is a hot wire ammeter fitted with a suitable shunt to act simply as an indicator of current in the aërial circuit. *E* is an earth arrester gap, consisting of two parallel brass discs, separated by a thin sheet of mica, the top disc being of smaller diameter than the lower. In this way a small air gap is provided, across which the oscillations can readily pass during transmission, but which effectively blocks the received signals, the received signals thus passing through the receiving apparatus which is joined across the two discs.

In transmitting on the 300-metre wave, the switches $S_1$ and $S_2$ are closed and $S_3$ is open. The condenser *C C* is charged by the



Digitized by Google

low-frequency supply round the inductance $P$, thus charging under resonance conditions and keeping the power factor constant, but discharges with H.F. oscillations through $C_1$, $I_4$, $I_3$, $D$, and $C$ $C$. This circuit is tuned to 300 metres, $C_1$ being equal to $C$. The aërial is direct coupled to this circuit through the inductances $I_3$, $I_4$ and the leads joining them to the spark gap. The wave length of the aërial is reduced by inserting a condenser $C_2$ of such a value that the wave length of the aërial circuit $A$, $C_2$, $I_4$, $I_3$, $D$, $T$, $E$ is 300 metres. In this design the energy radiated on the 300 metre wave is very much less than that radiated on the 600-metre wave. The station, however, is normally designed to work on 600-metre




A. Transformer oscillation W.T. No. 1.
B. Inductance W.T. No. 1.
C. Switch wave changing No. 1.
D. Switch wave changing No. 2.
E. Inductance W.T. No. 5.
F. Condenser W.T. No. 10.
G. Condenser W.T. No. 2.
H. Ammeter aërial No. 1.
J. Discharger earth.
K. Insulators' messroom No. 3.
L. Switch tumbler No. 1.

2.—Fishguard Wireless Station. Arrangement of Apparatus.

and the arrangement allows for resonance working on the 300-metre wave, with sufficient power on the latter to work the Great-Western Railway boats, without interfering with the neighbouring stations, at St. Just and Seaforth.

General.—The D.C. mains are led into the building and go straight to the main switch; from thence they go to the motor side of the motor alternator through a motor starter, the motor starter being of the Bray, Markham and Reiss type, controlled by a tumbler switch placed close to the operator.

The A.C. mains go from the alternator to a switch fitted on the power board, and from thence to the primary of the transformer, the transmitting key and iron core inductance being in circuit. The power is broken directly on the transmitting key, no electro-magnetic key being used as difficulty was anticipated with the adjustment of



Digitized by Google

an electro-magnetic key at such high frequency. The connections on the H.T. side of the transformer have already been explained, and **2** shows the manner in which the apparatus is disposed.

The mast is an ordinary three part ship's mast, 150 ft. high. It was recovered from the old Seaforth Wireless Station, and after being overhauled and repainted was erected by the Sectional Engineer at Fishguard. The anchorages are made up of bent railway metals set in concrete, and were designed in the Wireless Section. They form a cheap and effective anchorage, as the rails could be obtained on the spot from the Great Western Railway Co. The stays are four 2-$\frac{7}{8}$ G.I. stay wire for the mainmast, four $\frac{7}{8}$ G.I. stay wire for the topmast, and four $\frac{7}{8}$ G.I. stay wire for the topgallant mast. It was originally intended to put up four cages to form an umbrella aërial, but later it was decided that the mast was not strong enough to withstand the pull of the cages in such an exposed position, and single wires were used. The aërial is insulated from the mast and the poles carrying the extension by vulcanised strop insulators. The four lower ends of the wires are bunched and taken to a Bradfield insulator fixed in the wall of the building, and the inside of the Bradfield connected to the internal apparatus.

The earth consists of twenty-four plates 2½ ft. by 5 ft. of stout galvanised iron placed vertically in the ground and bolted together to form two semicircles of 20 ft. radius. $\frac{7}{16}$ copper H.D. wires are soldered to the plates, three to each plate, the outside wires being common to two plates. The wires converge from the earth plates to a central point, and are carried above the ground and bunched at the central point. The bunched wires are fixed by means of a globe porcelain insulator to the top of a 10-ft. light creosoted pole. The two earth systems are connected together and a common wire is led into the building to the earth arrester gap. The ground at Fishguard is very rocky, and this type of earth was adopted to provide a capacity earth in addition to the ordinary earth.

RECEIVING GEAR.—The receiving gear is connected across the earth arrester gap, and consists of a multiple tuner which can be worked with either a magnetic or a crystal detector. The skeleton diagram of connections is given in **3**.

It will be observed that in switching over to the crystal an air transformer is joined across the detector terminals in place of the primary coil of the magnetic detector. As the multiple tuner is designed to work normally with the magnetic detector the inductance of the primary of the air transformer is made the same as that of the primary of the magnetic detector.

Low-resistance telephones are used for both magnetic and crystal working by the aid of a telephone transformer for the latter.

It should, perhaps, be added that the crystal receiver set shown

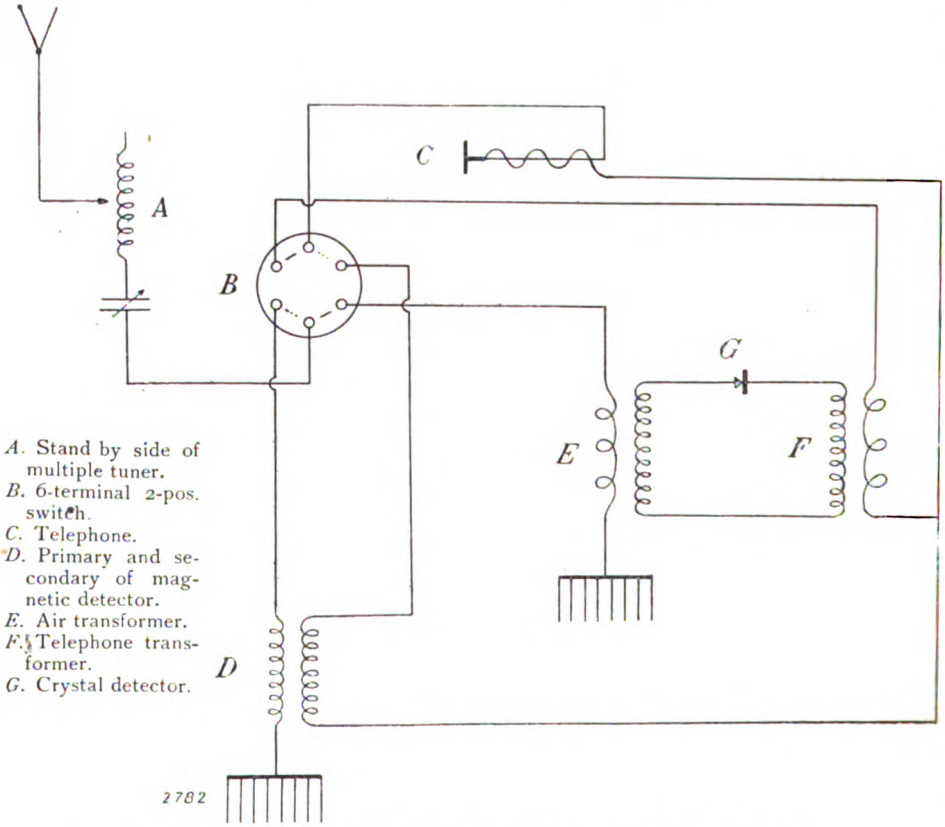


Digitized by Google

in the diagram was not available for the opening of the station, but separate pieces of apparatus serving the same purpose were temporarily fitted; the standard set, however, is about to be fitted.

The station was open for commercial work at the end of August, and Crookhaven in tests gave note clear and signals strength 6.

The range of the station is reckoned to be about 250 miles in the day-time, but it has taken traffic at 1200 miles at night.




*A*. Stand by side of multiple tuner.
*B*. 6-terminal 2-pos. switch.
*C*. Telephone.
*D*. Primary and secondary of magnetic detector.
*E*. Air transformer.
*F*. Telephone transformer.
*G*. Crystal detector.

3.—Fishguard Wireless Station. Receiving Circuit Diagram.

St. Just.—This is the second wireless station erected by the Department.

It was originally intended that power should be derived from a high-voltage supply to the mines in the district, but as the mains were not run it was found necessary to convert the transformer house into an engine and battery room, and to arrange for prime movers and batteries with the necessary accessories.

The lay-out of the operating building was prepared by the Wireless Section, and the erection of the building was arranged for and supervised by the Buildings Branch in the Secretary's Office.



Digitized by Google

In the case of both Fishguard and St. Just the instrument room, where the operating is done, is kept well away from the power room. The motor generator is started up by a remote control switch operating an automatic starter. This assures the necessary silence during reception of messages though the motor generator may be running.

The diagram of connections and general lay-out of the internal transmitting plant follows closely the lines of Fishguard. The fundamental differences are greater power—5 kw. instead of 3 kw. —and the provision of two aërials, one for the 600-metre wave and one for the 300-metre wave, instead of only one.

Using the same formulæ as those employed in the Fishguard case, taking the power at 5 kw., the frequency of the supply 200, and the open-circuit R.M.S. volts 300, we have:

Power = 5 kw.
Cap = ·07 m.f.d.
n. = 200 p.s.
Speed = 2000 r.p.m.

No. of studs on disc discharger:

$$= \frac{400 \times 60}{2000} = 12$$

If $v$ = spark voltage:

$$\tfrac{1}{2} \times \cdot 07 \times 10^{-6} \times 400\, v^2 = 5000$$

$$v^2 = \frac{50}{\cdot 14 \times 10^{-6}}$$

$v$ = 18,900 volts, say 19,000.

Open circuit:

E.M.F. generator = 300

$$\therefore E = 300\sqrt{2}$$

$$1 \cdot 57\, \rho \times 300\sqrt{2} = 19{,}000$$

$$\rho = \frac{190}{1 \cdot 57 \times 3\sqrt{2}} = 28 \cdot 6, \text{ say } 29.$$

The transformer was therefore specified for 300/8700 volts, but insulated in the secondary to carry the working load at 19,000 volts.

$$\text{Power} = \frac{E^2}{16\, nL}$$

$$L = \frac{(300\sqrt{2})^2}{5000 \times 16 \times 20} = \cdot 0112 \text{ henry.}$$

The inductance of the alternator was specified to be not greater than ·005 henry.

The added inductance is variable up to ·015 henry in 10 equal steps.

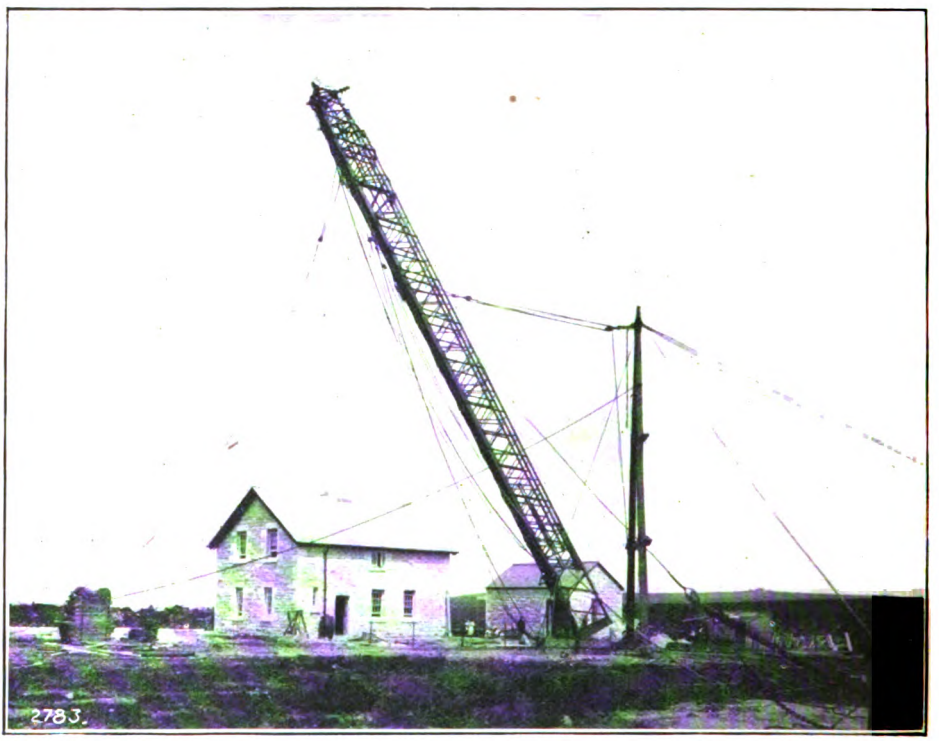
The alternator is fitted with 12 poles, and the E.M.F. is variable between 200 and 400 volts.



Digitized by Google

Although the capacity of the condensers in the primary circuit is approximately the same as Fishguard, yet, to allow for the greater power, the mass of dielectric is doubled. Hence twice the number of condensers of similar dimensions are used.

Two 200-ft. lattice girder steel masts support the aërials. The masts were designed by Mr. S. A. Pollock. It is not necessary, however, to dwell upon their design here, as the matter will be dealt with in a later issue of this JOURNAL.




4.—ST. JUST WIRELESS STATION. ERECTING ONE OF THE 3-SECTION LATTICE GIRDER MASTS.

Each mast is in three sections, the sections telescoping into one another.

4 shows the three sections nearly in position.

In raising the mast an axle was fitted to one side of the mast at the base and this was mounted so as to allow the mast to rotate in a vertical plane during erection.

When the three sections were in position the two inner sections were lifted vertically to the top of the outer section and the two outside sections bolted together. The innermost section was then lifted to the top of the second section and the second and third



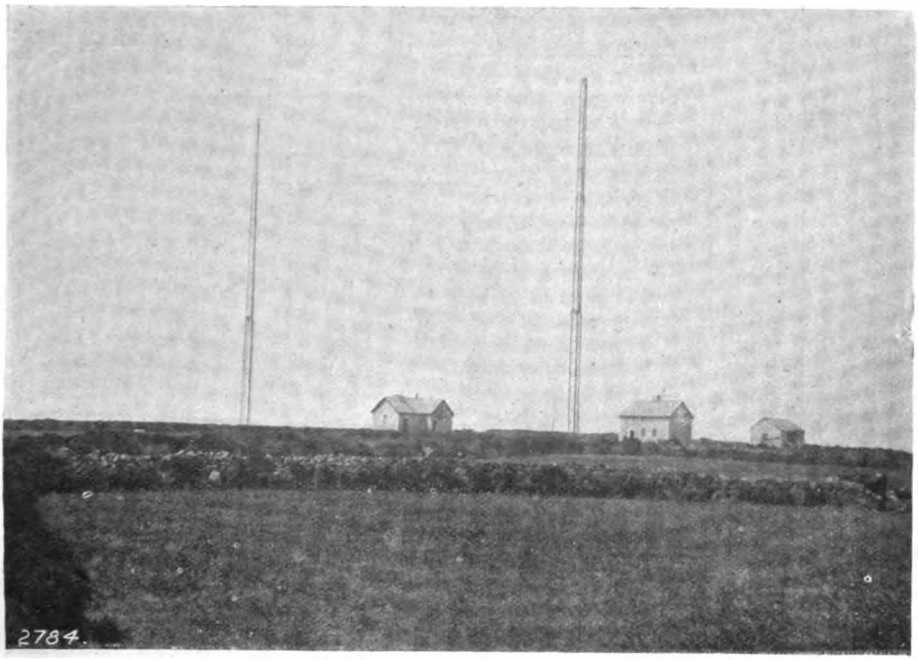
Digitized by Google

sections similarly bolted together. The completed masts are shown in **5**.

There are three sets of four stays to each mast, the stays being 2½″ steel rope.

A pulley is fitted at the top of each mast and over these run the halyards for supporting the aërial. The anchorages consist of re-enforced concrete blocks.

The 600-metre aërial is triangular in shape, the base of the triangle being at the top; each side consists of a cage made of six




**5.**—St. Just Wireless Station. The Masts completed.

wires of 7/19 H.D. copper. The two side cages are anchored down to ringbolts set in concrete in the ground.

The aërials are insulated from the masts and the ground by vulcanised strop insulators. Leads are taken from the bottom of the two legs to a Bradfield insulator fitted in the roof of the power room.

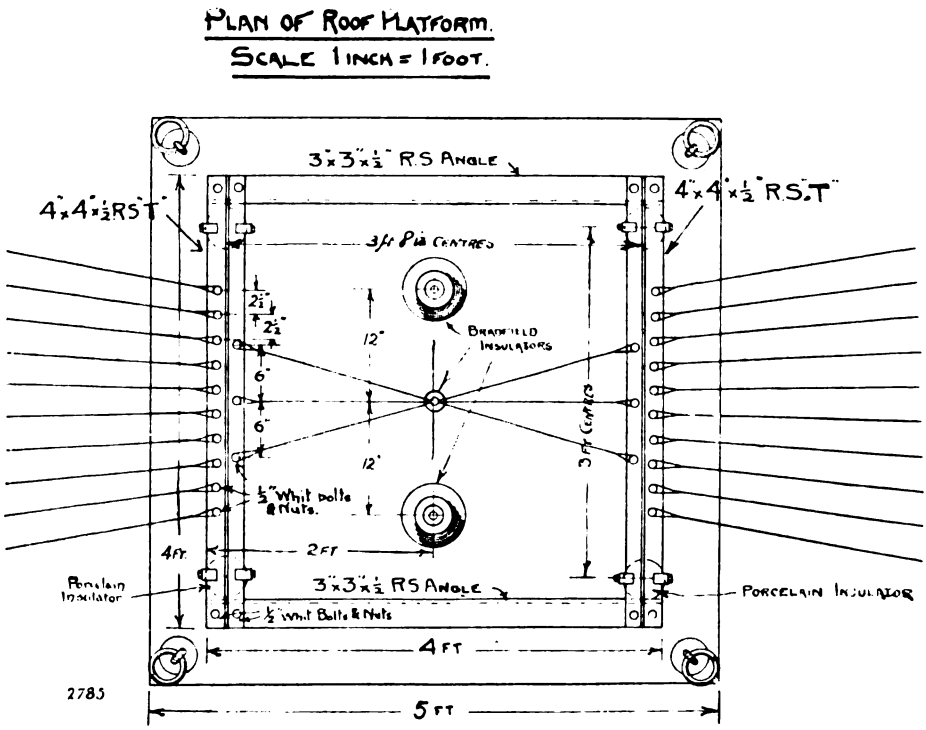
It was originally intended to strengthen the roof and to anchor the aërials to it, but this idea was abandoned. A special platform is built on the roof of the power room, and **6** is a plan of this platform. The leads from the 600-metre aërial go to one of the outside insulators and the lead from the 300-metre aërial goes to the other, the earth leads being joined to the centre one. The inside terminals of these insulators go to corresponding points of the internal apparatus.



Digitized by Google

The 300-metre aërial consists of two parallel wires 160 ft. in length and separated by wooden spreaders at the top and bottom.

The earth system consists of two sets of ten galvanised iron plates each 6 ft. by 3 ft. arranged in two segments of a circle of 80 ft. radius having as centre the mid-point between the masts. The plates are buried as vertical as possible without having recourse to blasting the ground, which is of a rocky nature. The longer edges are placed horizontally and bolted together at the upper corners so as to form a continuous sheet. To the centre of each plate a lead of




6.—RADIO INSTALLATION.

bare 100-lb. H.D. copper wire is soldered, the wire being passed in and out through three holes in the plate so as to form a good mechanical as well as a good electrical joint.

The earth leads are carried over short posts projecting 2 ft. above ground 5 ft. from the centre of each plate, and thence in a single span to a special earth bar carried on insulators on the roof platform over the high-tension room in the operating house.

A wire connecting each set of earth leads is carried to the centre insulator in the roof, the under side of the insulator being connected to the earth arrester gap. The earth bars on the platform consist of T. iron carried on Buller's third rail insulators.

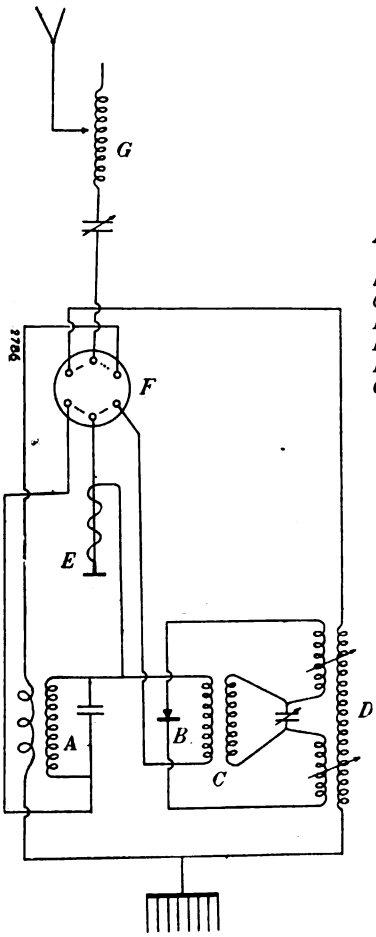


Digitized by Google

The prime movers are two semi-high-speed engines, each capable of developing 10 H.P. at 800 revs.

They are fitted with overhead valve gear and govern on the throttle.

In each engine the carburetter is of the single-jet automatic type and fitted with exhaust heated vaporiser. The carburetter is




*A*. Primary and secondary of magnetic detector.
*B*. Crystal detector.
*C*. Telephone transformer.
*D*. Air transformer.
*E*. Telephone.
*F*. 6-terminal 2-pos. switch.
*G*. Stand by side of multiple tuner.

**7.**—St. Just Wireless Station. Receiving Set Connections.

arranged for a petrol start and is turned over to paraffin when it warms up. High-tension magneto ignition is employed.

Each prime mover is connected to a D.C. generator designed for an output of 5 kw. at 100 to 140 volts at a speed not exceeding 700 revs. per minute.

The D.C. generator charges a battery of 52 cells suitable for a discharge of 378 ampère-hours at the 9-hour rate.

The battery supplies energy to a motor alternator; the motor is

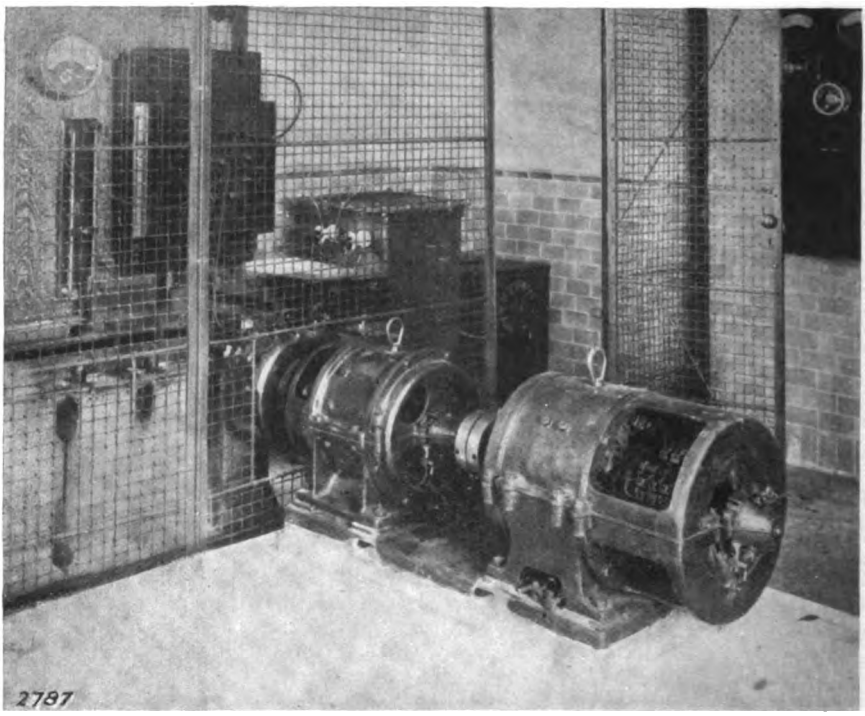


Digitized by Google

100- to 140-volt compound wound of sufficient power to drive the alternator and disc discharger; the alternator is designed to give a single phase current at 300 volts, 200 periods per second and a total output of 5 kw. at unity power factor.

Spare armatures are provided for all the machines.

7 shows the skeleton connections of the receiving set. It will be seen that in conjunction with the multiple tuner either a magnetic detector or crystal detector may be used. The arrangement of the air-transformer, with a split secondary winding having the telephones




8.—St. Just Wireless Station. Motor Alternator fitted with Rotating Disc Discharger and High Tension Apparatus.

at the split and the crystal detector across the outer terminals, was suggested by Mr. J. E. Taylor, and follows the arrangement used for coherer jiggers. This set has, however, only been installed temporarily, and will be superseded later by a standard set as at Fishguard.

In tuning up the station and testing with Crookhaven, 200 miles west, the signals were given: "Clear as a bell and very strong." A boat, 300 miles west, gave the signals as strong. It is impossible to say exactly at present what the range of the station is, but it is considerably in excess of that of Fishguard.



Digitized by Google

In installing the apparatus the electrical constants were slightly altered from those scheduled. Difficulty was experienced in arranging the circuits for the desired wave-length with so large a capacity.

Malin Head will follow closely the design of St. Just, but there will be only one mast and one aërial instead of two.

Malin Head, Valencia, and Niton Wireless Stations will be completed early next year.

---

## RECENT DEVELOPMENTS IN TRANSPORTATION.

By H. C. GUNTON, M.I.E.E.

A CONSIDERABLE amount of attention has recently been given to the application of mechanical power for Post Office transportation purposes, and the following notes on some of these schemes will probably be of interest.

### SORTING OFFICE CONVEYORS.

The sorting offices in the larger postal centres offer a wide but by no means an easy field for the ingenuity of the designer of mechanical appliances. Before proceeding to describe what has been done in this direction it will be well to state briefly the processes through which a letter passes in one of these offices, choosing a simple case of what is known as "outward sorting" for the purpose of explaining the objects to be kept in view.

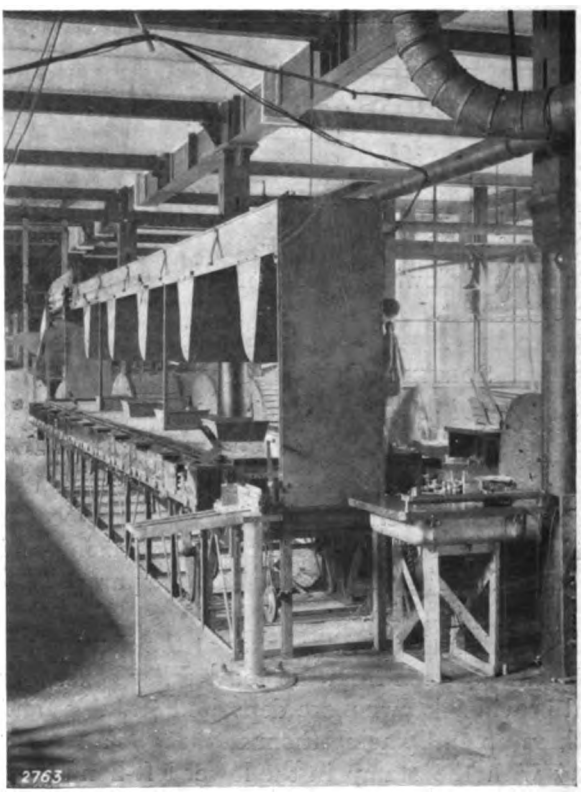
Letters inserted in the posting boxes at the Head Post Office, or brought in by the postmen from the local pillar-boxes, say at one of the principal provincial towns, are deposited on tables and "faced" by picking them up and placing them so that the addressed sides all face one way with the stamp in the lower left-hand corner. The faced letters receive the locality and time impression and have their stamps obliterated. They are then taken to the primary sorting tables and sorted into twenty or thirty "roads," each of which may include several towns or districts. The letters for each road are next taken to secondary sorting or despatch tables where they are further sub-divided and made up into bundles which are placed in bags in which they are conveyed to the railway stations. It should be stated that bags of mail matter received from the railway stations similarly pass through a process of "inward sorting" before delivery, but the above explanation of "outward sorting" will probably suffice.

It will be understood that while there are certain selective



Digitized by Google

processes which can only be carried out by human agents, there is scope for mechanical transportation between the processes. Until recently the conveyors which have been used in sorting offices, and with which no doubt readers generally are familiar, have been installed in order to facilitate operations carried out, more or less, in accordance with existing ideas. The difficulties in design involved in adapting these appliances to these operations in old offices,




I.—MECHANICAL SORTING. FACING TABLE.

constructed and arranged without reference to their embodiment, have, of course, been very considerable.

Experiments have recently been made which aim at the mechanical transport of correspondence practically right through an office, from the posting boxes to the despatching tables and thence to the loading platform.

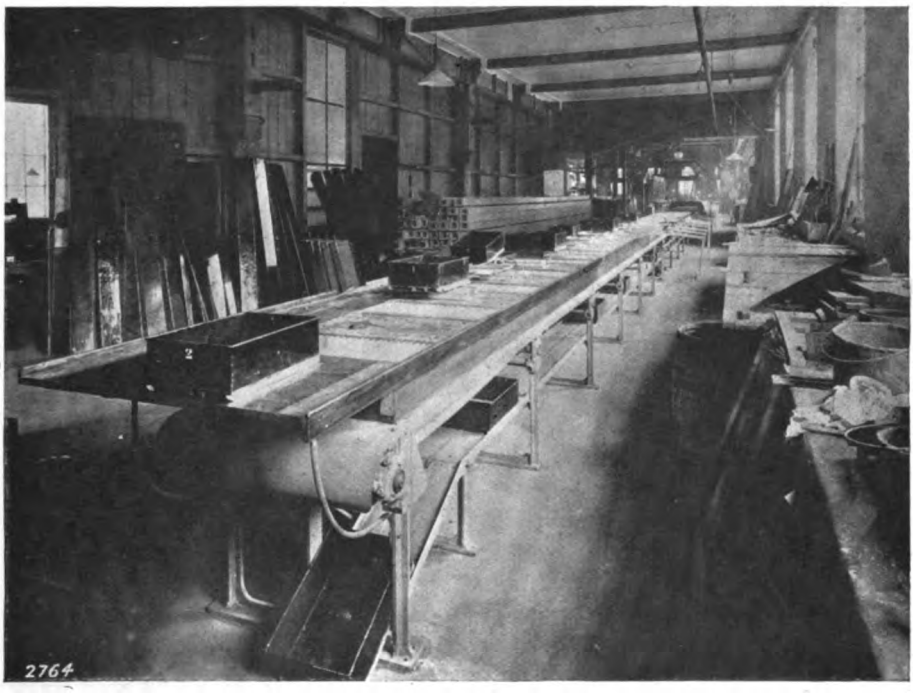
The practicability of conveyors from posting boxes to facing tables has already been proved, and bands are also in use carrying faced letters from one end of a facing table to the other, but the



Digitized by Google

experimental installation provides for the stamping machine at the end of the table being fed mechanically instead of by hand.

In framing the complete scheme, it was assumed that all correspondence would be received on a platform at one end of the sorting office adjacent to the facing tables, and at this platform one man is required to watch and adjust the flow of work along the facing tables, the letters, etc., being carried by bands above these tables and deflected at will (through shoots) to the facers at their various positions along the tables. At intermediate positions (between these




**2.**—MECHANICAL SORTING. PRIMARY SORTING TABLE.

overhead shoots) there are openings in the table through which the newspapers and packets picked out from the general correspondence are dropped on to the return half of the band which is carried beneath the table, and deposits them at the end of the table for separate treatment.

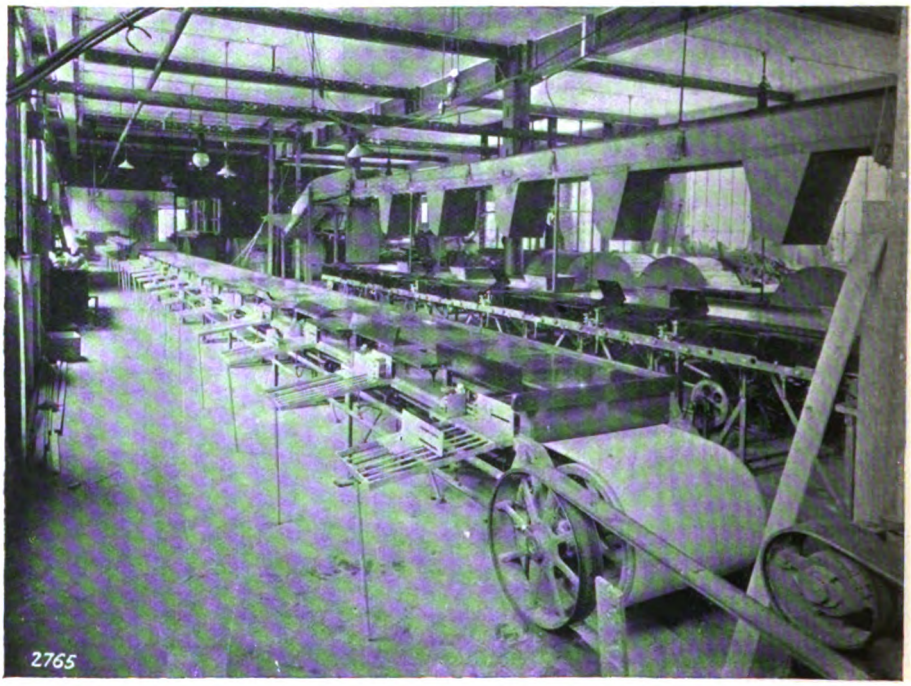
The facing table has along its edge a series of slots formed by smooth sheet iron or wood, through which the facers drop the letters, in an upright position, on to a running band below the table. Each of these individual slots forms a "siding" leading to a main slot which runs from end to end of the table, and into which the letters pass without "fouling." At the end of this main slot the letters are



Digitized by Google

mechanically separated and fed direct into the stamping machine, and then "stacked" by the mechanical stacker which forms part of the machine.

As an alternative arrangement each small slot or "siding" is fitted with its own stamper, consisting of an impression roller and die. By this means noise is reduced, there are fewer failures, and it is possible to fit a mechanical counting device to each stamper so that the output of each facer can be ascertained. On the other hand the periodical changing of so many dies causes some additional work.




3.—Mechanical Sorting. Despatch Table.

The letters are automatically stacked at the end of the table.

We have so far followed the letters through the facing, stamping and stacking processes.

At this point attendance is required to transfer the stacked correspondence into boxes, which, when filled, are carried away by a specially designed chain conveyor to selected points on the primary sorting table. The boxes travel along the back of the sorting table and are delivered automatically at the side of the sorters, being deflected on to moving platforms which move out to meet their respective boxes.

As the sorters empty their boxes, they send them back to the



Digitized by Google

machine (empty) by a similar conveyor, and the officer there refills them in turn and places them again (full) on the conveyor. As the conveyor discharges them only at the particular points from which they have been returned as empties, the sorters are kept supplied without any trouble.

The primary sorting is done through a grid (*i. e.* through vertical slots) on to a wide band running below the table. For each division

4.—Mechanical Sorting. Primary Sorting Table with Covers removed.

or "road" a slot is provided, one inch wide, and a sorter can have as many as twenty-four divisions easily within his reach.

The width of the "bay" for each man is only 2 ft. 6 in. and the sorters thus stand shoulder to shoulder.

From the primary table the band runs to the dispatching tables, and at each "road" the slot carrying the correspondence for that particular "road" is turned outwards to the front edge of the table so as to discharge the correspondence proper to that road, and at that point it is stacked again by a mechanical stacker ready for the secondary sorting. It will thus be seen that the correspondence



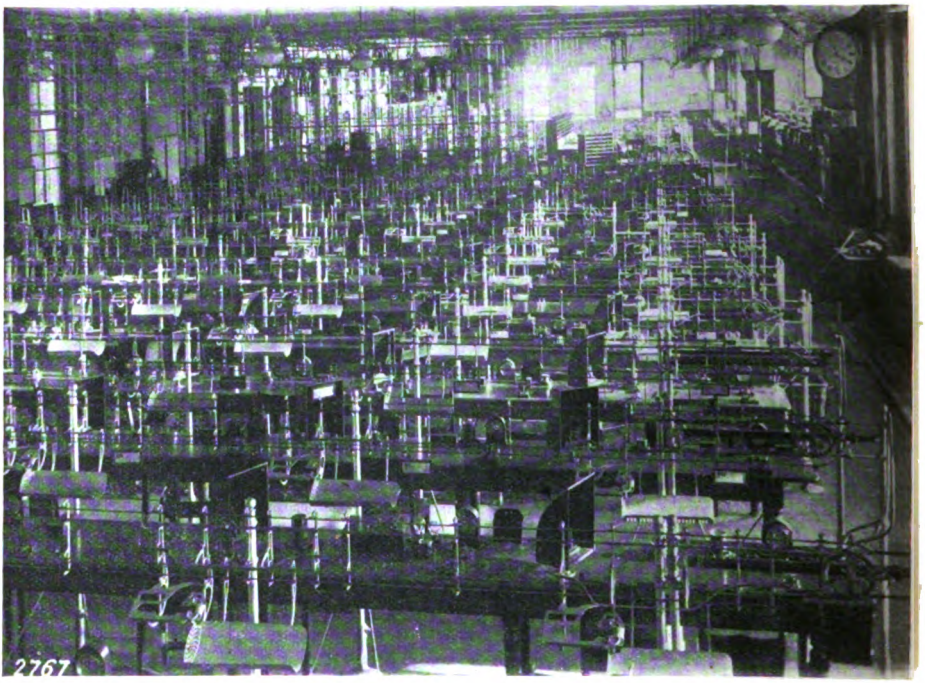
Digitized by Google

passes direct from one process to the next without any delay such as is inherent to hand collection.

The experimental apparatus has been installed at Liverpool Post Office, and the preliminary trials have been satisfactory and indicate a substantial saving of time over the existing methods.

Improvements are at present being made in one or two points of detail and it is, of course, too early to say how far these new methods can be generally applied.

1 shows the facing table, stacker and stamper.




5.—Pick-up Carrier. Birmingham Instrument Room.

2 shows the primary sorting table, and conveyors for distributing the baskets of faced letters.

3 shows the despatch-table and stackers. A side view of the facing table is also shown.

4 shows another view of the primary and part of the despatch-table, with some of the covers removed in order to show the slots.

The whole of this experimental apparatus is electrically driven.

## Telegraph Instrument Room Conveyors.

In telegraph instrument rooms the problem has been how to

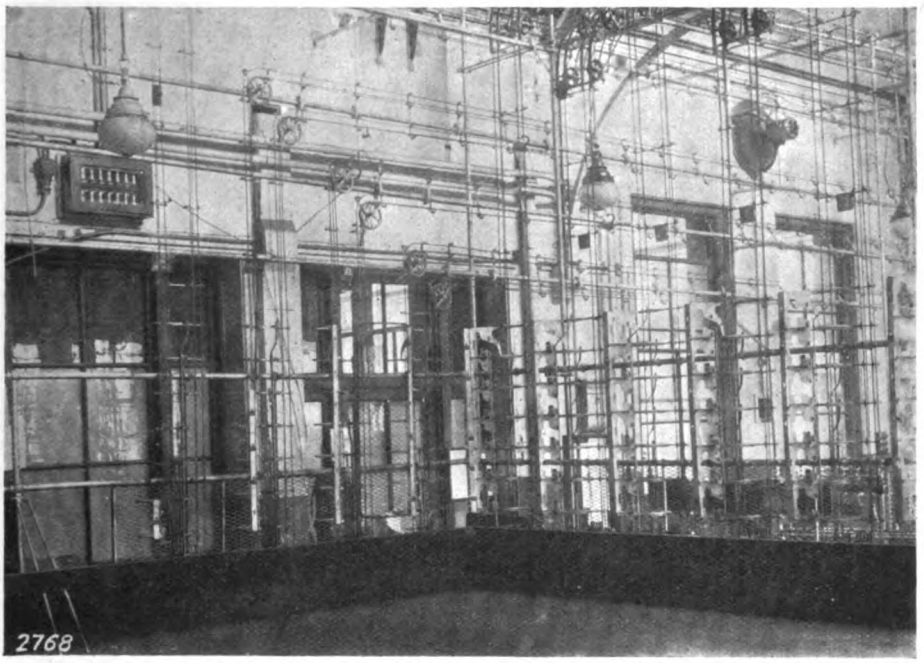


Digitized by Google

displace boy labour by means of mechanical appliances which would save time and which would meet the following conditions:

(1) The system of mechanical appliances should, as far as possible, be uniform throughout the instrument room, and the control should preferably be concentrated at a central point.

(2) The apparatus must be automatically selective as regards distribution to the operators, *i. e.* it must be possible to despatch a telegram form to any desired point on any table. The forms must also be conveyed from any point on any table to the check table, but this is not a selective operation.




6.—Pick-up Carrier. Birmingham. Another View.

(3) The despatch of the telegraph forms by the various operators should not involve any further break in the continuity of their work than is at present involved by the placing of the forms on the message baskets provided, and from which the boy messengers collect.

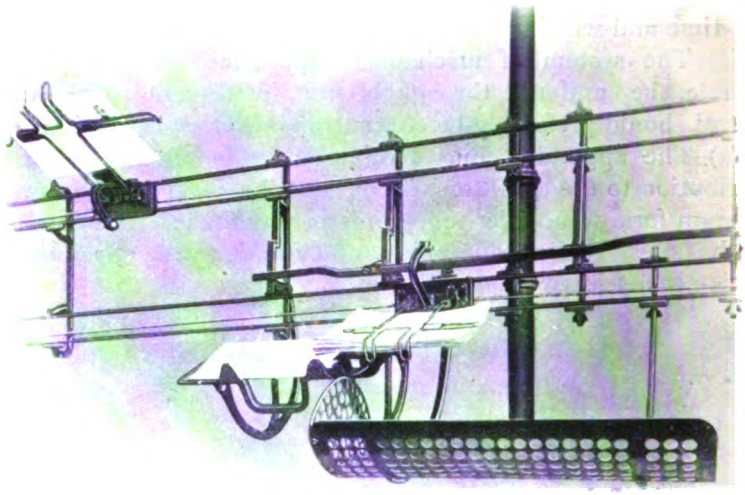
(4) The apparatus must be silent in its operation, and moving parts must be arranged so as to obtrude to the smallest possible extent on the vision of the operators.

(5) The gangways and the lighting of the instrument room should be interfered with to the smallest possible extent.

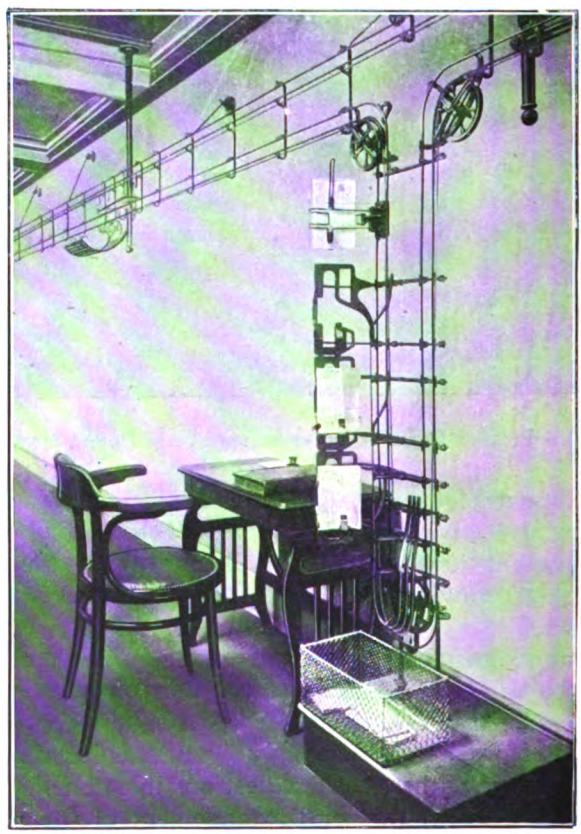
**5**, **6**, **7** and **8** show the general arrangement of the plant which



Digitized by Google



7.—Pick-up Carrier. Details of Horizontal Run.



8.—Pick-up Carrier. Elbow and Vertical Detail.



Digitized by Google

has been installed experimentally at Birmingham. "Pick-up" carriers bring the incoming telegrams from the various operators' stations and drop them on to band conveyors, which deliver them at the "check" table, whence they have to be distributed selectively to the operators who deal with outgoing circuits. This selective distribution is effected by placing the telegrams on tablets arranged vertically in groups of five or six corresponding to the various stations on each table.

The endless cord running between the "central check" and each table draws the selective carriers, the jaws of which, by means of ramps, are made to open and close and so pick up the telegrams only from their proper tablets and similarly to deliver them only at their proper stations. The carriers also pick up at the table stations and deliver on to the bands at the check table referred to above. The carrier installation has been supplied by Messrs. Lamson, while the band conveyors have been installed by the Post Office. The cord and band conveyors are driven by electric motors placed underneath a platform at the "central check."

## Post Office (London) Railway.

As no doubt our readers are aware, powers have recently been obtained to construct an electric railway for purely postal purposes between the Paddington District Post Office in London Street and the Eastern District Post Office at Whitechapel, with intermediate stations at the Western District Parcel Office, at the Western District Post Office, at the Western Central District Post Office, at Mount Pleasant Sorting Office, at King Edward Building Post Office, and at Liverpool Street Station.

The railway contemplated under the present scheme is indicated in full lines, while the ultimate extensions contemplated are indicated by dotted lines on 9.

Between the stations the railway will consist of two tracks, each 2 ft. gauge, one for east-bound and the other for west-bound traffic, and contained in a single tunnel of 9 ft. internal diameter.

A complete scheme has been worked out in detail in collaboration with Mr. Dalrymple Hay. The latter is responsible for the tunnelling, while the Engineer-in-Chief is responsible for the equipment.

Three of the stations, viz. the Western Central District Office, Mount Pleasant, and King Edward Building, will form important junctions when extensions to the north and south are undertaken.

It is intended that the trains shall be operated without drivers on the remote control system.

The present is clearly not a convenient or proper time to give a detailed description of the scheme, which, whilst it will form the

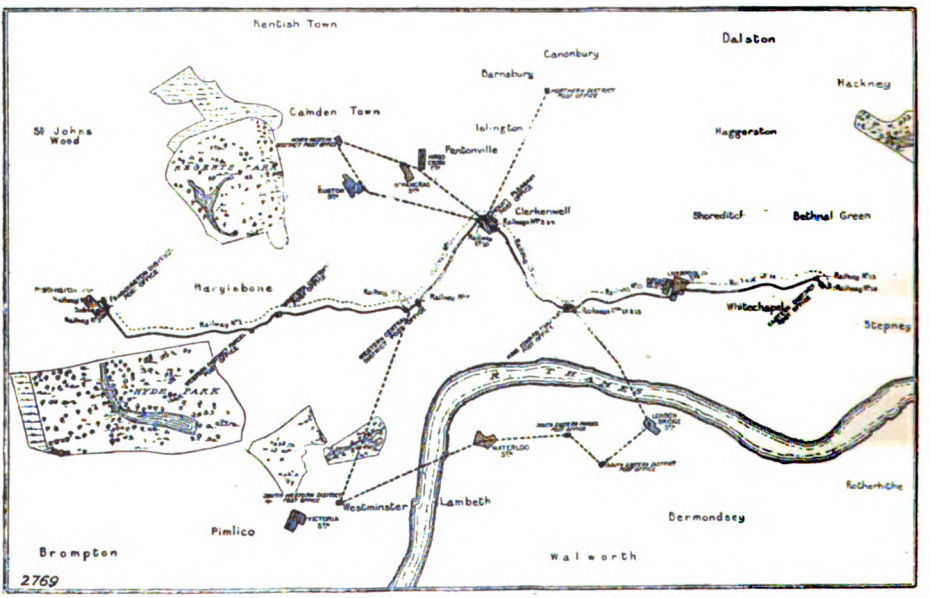


Digitized by Google

basis of invitations to tender, will leave the way open for alternative proposals as regards the electrical equipment.

A brief reference to the main outlines of the model scheme may, however, be of interest at this point in view of the information which has already been published.

A station will consist of an island platform arranged in two sections, between which will be placed a control cabin, and the lifts and conveying appliances which have been specially designed to suit the different classes of postal matter which have to be dealt with between the station platforms and the postal buildings above. This is the general design of station which has been adopted in all cases,




9.—Map of P.O. Tube Railway.

the arrangement of the tracks and of the conveying appliances being adjusted to suit the requirements at the different points.

It is proposed to operate the wagons or trains by three types of current, which it will be convenient to refer to as high speed (H. S.), intermediate speed (I. S.), and low speed (L. S.). Between the stations the H. S. current will be applied. At the approach to a station the wagons will pass over a short gap in the conductor rails, and brakes (which will be electrically released when the train is taking current and applied when the train is not taking current) will be applied. The next section of conductor rail will normally be "dead," and will be of such a length as to allow the wagon to come to rest, the brake remaining on.

In the case of a wagon which is required to stop at the station,



Digitized by Google

a L. S. current will be applied to this brake section, and the train will move to the station platform and will finally be brought to rest owing to the application of the brakes when it reaches the sub-section of the station platform, the conductor-rails of that subsection having been made "dead" for its reception. In the case of a through train, I. S. current would be applied to the brake section, and the wagon would run at this speed through the station, would pass over a short gap in the conductor-rails, and then on to the sections of the track energised by H. S. current without a stop. In the event of its being possible to accept, without delay, either a stopping train or through train, the braking section, or a certain portion thereof, would be energised with L. S. or I. S. current respectively before the train reached that section, in which case the train would merely be retarded down to the speed corresponding to the current applied and would either pass up to the platform or straight through the station. A wagon will be despatched from the station by making alive the conductor-rails of the sub-section on which it has been standing with I. S. current if it is being sent on to a main line or with L. S. current for shunting operations.

Wagons will be moved into the sidings and brought to rest in certain sections in the same manner as at the platforms, and a device will be provided for automatically reversing the connections of the motors, when desired, just as they are coming to rest, so that they may move off in the opposite direction when current is applied to withdraw them from the sidings. Means will also be provided for holding the brakes off without applying driving current to the motors so that the wagons may readily be coupled up to form two or three car trains. When coupled up in this manner it will be arranged that by means of a train cable and certain switches the shoes of the rear wagon only will collect current from the conductor rails, but the motors on all wagons will be operative and share in the driving of the train. This arrangement will overcome difficulties which would otherwise arise in dealing with both single wagons and trains at gaps, braking sections, and dead sections, at the platforms and in the sidings.

It should be made quite clear at this point that it is not intended that the control of the wagons as they come to rest in, or pass through, the stations should need the continuous attention of the switchman.

The position and destination of each wagon will be notified to this officer, who, by means of small levers in the cabin, will set points for the particular route desired, and will energise certain sections of the conductor rails with the appropriate current. The wagon will then come to rest at the proper section of the platform, or will run through the station, without further attention.



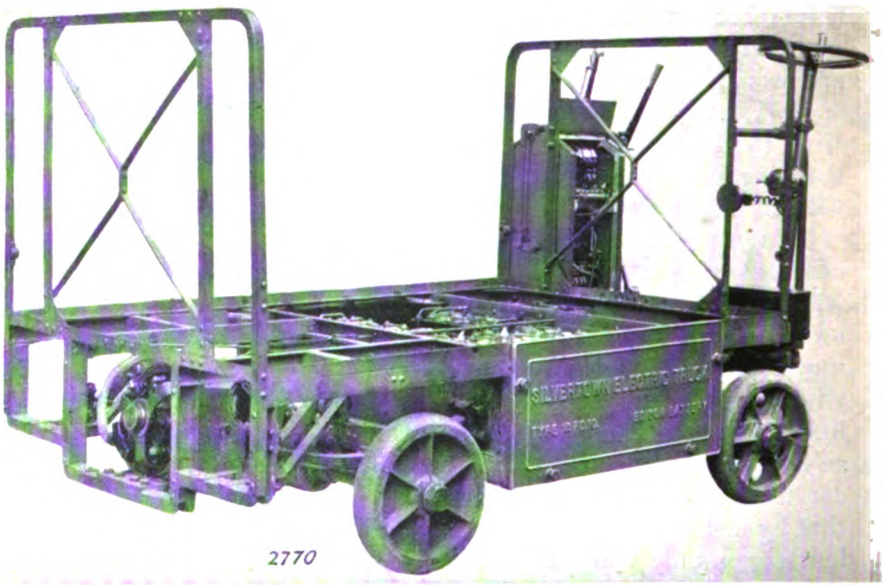
Digitized by Google

The operation of the points will be interlocked with the application of the current and there will be a complete interlocking arrangement between the different routes.

The proposed system of control may be briefly described as being generally similar to the power-operated point-and-signal systems adopted for modern railway undertakings but with the signal element replaced by the application of current to the track.

It is considered that it is only by such a system of complete interlocking that a remote control electrical railway of this scope can be safely operated.

Between stations the conductor rails will be divided into sections,




10.—Electric Truck. Flooring and Sides removed.

and while running between stations and before coming within the control of the switchman the wagon will itself render each section "dead" as it leaves it, and will make it "alive" again on entering the next section but one, that is to say, there will always be a "dead" section between adjacent wagons.

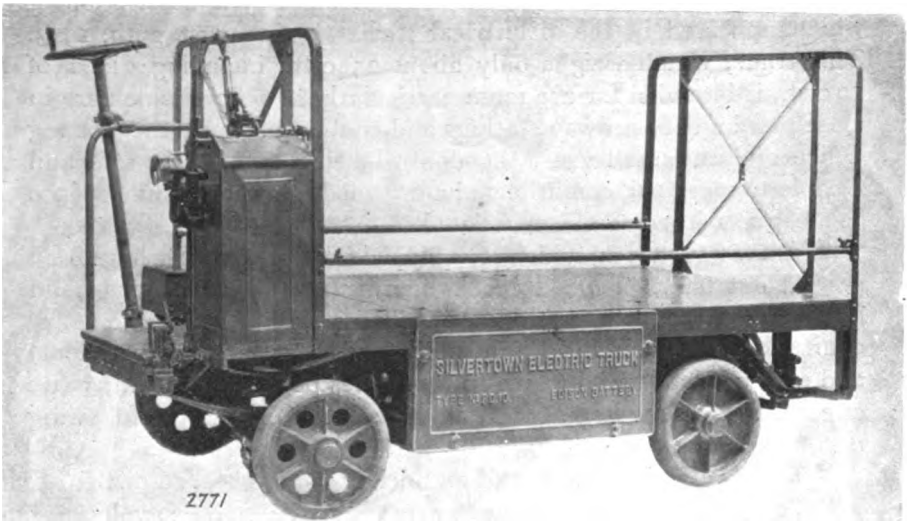
Means will be provided for indicating, not only the position, but also the destination of approaching trains and so enabling the switchmen to arrange for their reception either separately or simultaneously as the case may be, being protected against mistakes by the interlocking arrangement which has been described above.

Possibly, at a later stage, a separate article may be written on this railway and its equipment, as the problems which have presented

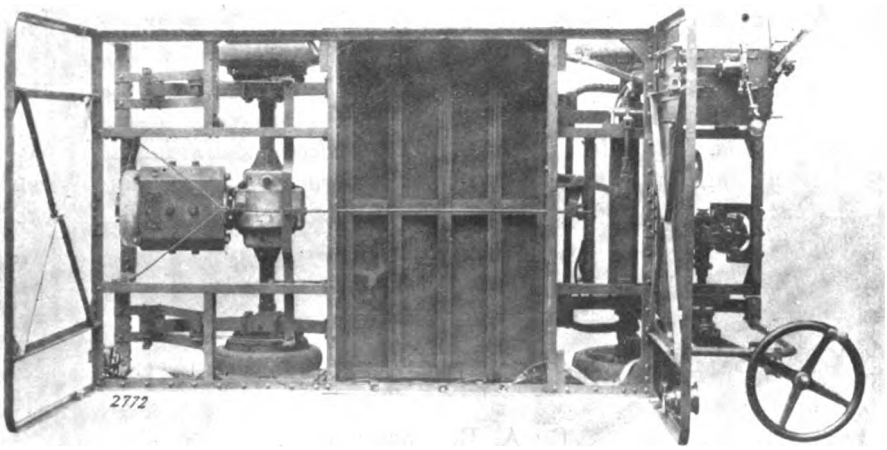


Digitized by Google

themselves for solution have certainly proved very interesting, and in many respects novel.




**10a.**—Electric Truck. Complete.




**10b.**—Electric Truck. Plan of Frame.

## Electric Trucks and Vans.

The electric railway is not the only direction in which the employment of electric traction for postal purposes is being introduced.



Digitized by Google

With a view to reducing human labour and delays connected with double handling, trials are at present being made with an electric truck equipped with an Edison battery, a description of which appeared in the 'Electrical Review' of August 29th, 1913. This truck, which weighs only about 25 cwt., including a load of 10 cwt., is intended for use more particularly at offices which are in close proximity to railway stations and can ply between the Sorting Office and the mail vans, the control being sufficiently safe and flexible to meet the conditions of a crowded platform, while slopes as steep as 1 in 10 can be negotiated.

Trials of the truck, which is equipped with 42 B4 cells, have been carried out on level wood block flooring (the truck having solid indiarubber-tyred wheels 15 in. in diameter) over a rectangular course 824 ft. per circuit at full speed (five to seven miles per hour) and at about half speed (three to four miles per hour) over alternate circuits and with a stop at the end of each circuit, and the following results have been obtained;

| | |
|---|---|
| Total weight of truck, load and driver | 26 cwt. |
| Voltage before run (half battery) | 30 volts |
| Voltage after run (half battery) | 20 volts |
| Total number of journeys | 160 |
| Number of miles | 25 |
| Charging units | 7·3 |
| Watt hours per ton mile | 225 |

10, 10A and 10B are views of the truck.

Experiments are also being made with electrically equipped vans for collecting purposes.

[*We are indebted to the Institution of Electrical Engineers for permission to print the foregoing, which was extracted by Mr. Gunton from his paper on "The Employment of Power in H.M. Post Office," read before the Institution on December 18th.*]

---

## PNEUMATIC TUBE HAND PUMPS.

By A. B. Eason, M.A.

There are a considerable number of hand-pumps in use in the country, and the following information as to the probable power required to work them may be of interest. The amount of work actually required to send carriers through the 1½ in. brass tube and lead tube varies with the length of tube, size and type of pump, state of pump, type of carrier used, and whether the carrier travels up or down. To evaluate the work done in any particular case is



Digitized by Google

difficult, as there is no ready simple means of integrating "force × space" when working a hand-pump.

The results of tests made upon hand-pumps in London do, however, furnish results which give some idea of the work necessary, though they cannot be vouched for as highly accurate.

The tests were made by fastening a spring balance to the handle and watching the force required to move the handle, noting the number and length of strokes. The balance read up to 20 lb. and had a 7 in. dial; the pointer rose quickly to a value 4, 6, or 10 lb. or so and varied 1 or 2 lb. at that value, and then dropped at the end of the stroke. A mean value was then chosen and multiplied by the stroke to obtain the foot-lbs. used.

The figures in this article are the results of tests taken by Mr. W. G. Carter in 1911 and by myself in 1913. All the tests were made in London offices and practically all with No. 1 hand-pumps having a cylinder of 6 in. diameter. The tests show that the foot-lbs. of work required to send leather carriers No. 4 or No. 5 through a 1½ in. brass tube are roughly: $15 + L$ when sending up between floors; $L - 10$ when sending down between floors; $L$ when sending on same floor. $L$ is the equivalent length of straight tube and equals $l + 6' b + 3' s$, where $l$ is the actual length in feet, $b$ is the number of bends, and $s$ the number of sets. These equations hold up to $L = 100$ feet, but for larger values of $L$ they should be increased, I think. A sufficient number of long tubes are not available in London to allow of tests being made to determine the force accurately.

The steady pull on the handle of horizontal pumps when no carrier is in the tube is about 3–4 lb. when one double stroke is made each two seconds. In the case of vertical pumps it is slightly greater, say about 5–6 lb. When sending carriers the pull on the handle varies from 7–14 lb. at strokes 14 in. to 18 in. long. The number of strokes required is approximately 2, 3 or 4 double strokes according as the equivalent length, $L$, of the tube is 30–40, 40–50, 50–100 ft. When driving carriers up vertical tubes quick strokes should be used as otherwise the carriers tend to fall back after each stroke. Now and then one comes across stiff pumps which require about 3–6 ft. lbs. per stroke more than usual. This is a serious item of work if there are a large number of carriers to be sent.

This information together with other information concerning telegraph and carrier traffic enables one to place facts before the Secretary, postmasters and medical officers which should assist in determining the suitability of counter clerks working hand-pumps.

Taking the following example, the Postmaster of X—— states that the counter clerks find the work at the hand-pump too heavy. The



Digitized by Google

message traffic is 60,000 forwarded messages a year; the estimated daily maximum is $\frac{60{,}000}{300} \times (2{\cdot}0) = 400$. During the day about 250 carriers will be used, and during the four busiest hours there will be approximately 40 per cent. of this traffic, *i.e.* 100 carriers. The counter tube is 80 ft. long and has four bends; to send each carrier requires $15 + L$ ft. lbs. = 119 ft. lbs. The work done per hour will be about 2920 ft. lbs., but this will be done in $25 \times 5$ seconds = 2 minutes; the rate of working is ·0442 H.P. The work done in pumping in the busiest hours is $117 \times 35 = 4080$ ft. lbs., and in the four busy hours 11,700 ft. lbs. This amount will be nearly doubled if the pump is stiff, and will be increased appreciably if the feed slide is very leaky. Whether the counter clerks should be expected to do the work is for medical men to decide.

*Summary of Statistics; Offices with Pneumatic Tubes Worked by Hand-Pumps*, 1912–1913.

| District. | No. of offices. | No. of pumps. | No. of tubes. | Total length of tubes; yards. | Average length of each tube. |
|---|---|---|---|---|---|
| Northern | 11 | 14 | 18 | 379 | 21·1 |
| N. Eastern | 9 | 12 | 14 | 206 | 14·7 |
| N. Western | 25 | 35 | 36 | 689 (170*) | 19·1 |
| N. Wales | 17 | 22 | 24 | 476 | 19·7 |
| N. Midland | 29 | 32 | 37 | 698 | 18·9 |
| S. Midland | 30 | 36 | 38 | 555 | 14·6 |
| S. Wales | 25 | 28 | 31 | 542 | 17·5 |
| S. Eastern | 25 | 37 | 38 | 638 (90*) | 16·8 |
| S. Western | 24 | 29 | 29 | 613 | 21·2 |
| S. Lancashire | 2 | 2 | 3 | 72 | 24·0 |
| Eastern | 19 | 25 | 25 | 341 | 14·6 |
| Ireland | 30 | 32 | 32 | 496 | 15·5 |
| Scotland East | 21 | 25 | 25 | 520 (116*) | 20·8 |
| Scotland West | 24 | 25 | 26 | 423 | 16·4 |
| Total | 291 | 354 | 376 | 6648 (376) | 17·7 |
| London | 49 | 68 | 116 | 2600 ? | — |
| Total | 340 | 422 | 492 | 9624 (say 5½ miles) | — |

* One single tube; not included in average length.



Digitized by Google

332

## THE NEW ANGLO-IRISH TELEPHONE CABLE.

THE new Irish telephone cable, which is to serve as the main trunk route between the southern half of the United Kingdom and Ireland, is the longest submarine loaded cable yet laid by the Department. Its total length is approximately sixty-four nautical miles, being thus some sixteen nautical miles longer than the Anglo-Belgian cable, which was laid in 1911 (described on pages 50–58 of Volume 5 of this JOURNAL). In several respects the two cables are similar in construction; the dielectric in each consists of the specially treated gutta-percha patented by Messrs. Siemens. They are both loaded on the transformer and phantom circuits, with coils spaced one nautical mile apart; the 7-wire copper strand forming each of the four conductors weighs 160 lbs. per nautical mile, and the dielectric 150 lbs. in both cases. The over-all weight of the completed cable is some 12½ tons per nautical mile. Where the coils come in, the cable is strengthened by extra sheathing for about 92 feet. The following are the particulars:

| | |
|---|---|
| Length of double sheathed portion . . | 92 feet |
| Weight of the 92 feet . . . . . | 8·0 cwt. |
| Weight of 92 feet of ordinary cable . . | 3·85 ,, |

A special feature of this cable is the provision of a fifth core of 50 mils copper G.P. insulated, which runs in the centre for half a naut. at each end of the cable. It is then brought out by means of an insulated iron strand, which is bound in and soldered to the sheath. This wire has been provided as an earth wire in connection with experiments on single-wire submarine telephone cables which are at present being conducted. The object of the length of half a naut. is to permit of the earth wire being taken out to sea and soldered to the sheath, so as to avoid the inductive disturbance which is generally found, to a greater or less extent,

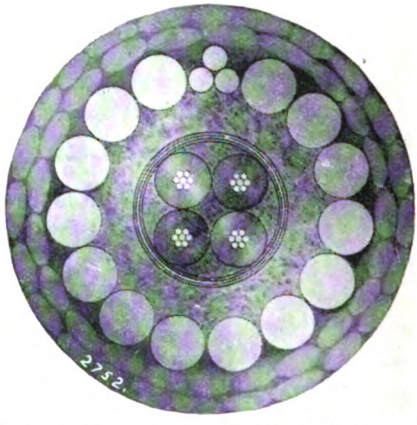


Digitized by Google

when earths are made in a cable hut, especially when telegraph cables are terminated in the hut.

The value of the attenuation constant $\beta$ was specified not to exceed ·016 per naut. when the transformer circuits and superimposed circuit were tested with a sinusoidal electro-motive force, having a periodicity of 800 per second, applied directly to the end of the cable, and producing one milliampère at the sending end.

The results obtained on the completed cable were as follows. A "Franke" machine was used for the tests.




SECTION OF NEW ANGLO-IRISH TELEPHONE CABLE. FULL SIZE.
*(From a drawing kindly supplied by Mr. Dieselhurst, of Siemens Brothers.)*

TRANSFORMER CIRCUIT.

| Angular velocity ($2\pi n$) of testing current. | ATTENUATION CONSTANT $\beta$. Mean values. | CHARACTERISTIC IMPEDANCE $Z_0$. Modulus. | Angle. |
|---|---|---|---|
| 3000 | 0·0138 | 665 | $-5^\circ 45'$ |
| 5000 $\phi$ | 0·0150 | 690 | $-2^\circ 40'$ |
| 7000 | 0·0168 | 695 | $-2^\circ 40'$ |

$\phi$ Specified angular velocity.

SUPERIMPOSED CURRENT.

The attenuation constant when $2\pi\eta$ equals 5000 is 0·0150.
The characteristic impedance $Z_0$ equals 446 $0^\circ 52'$.

The transformer circuits (the two diagonal pairs) have thus a standard cable equivalent of approximately nine miles.

The efficiency of the coils is such that, when taken separately, the ratio of the effective resistance ($R$) to the inductance ($L$) in each case is $\frac{R}{L} = 48$.



Digitized by Google

The constants of the completed cable per naut. loop are as follows.

| | Resistance of circuit without coil. | Effective resistance of coils at $2\pi n = 5000$. | $S/K$. | Inductance (millihenries). | Wire-to-wire capacity (mfs). |
|---|---|---|---|---|---|
| Transformer circuits | $14{\cdot}2^{\omega}$ | 6·8 | 15 | 100 | 0·166 |
| Superimposed circuit | $7{\cdot}1^{\omega}$ | 3·2 | 15 | 50 | 0·320 |

Where $S$ is the leakance in mhos and $K$ is the capacity in farads.

Overhearing was specified on the completed cable between either of the transformer circuits and the superimposed circuit to be not greater than would be observed in direct speech over 65 miles of standard cable having a resistance of 88 ohms per mile loop and a wire-to-wire capacity of ·054 microfarads. The figure of 65 miles was stipulated because a similar result was obtained in the Anglo-Belgian cable, and it was feared that a higher figure could not be guaranteed.

The copper conductors are of 100 per cent. conductivity to E.S.C. standard for annealed high-conductivity copper. The sheathing wires, fourteen in number (with an additional 3-wire strand to indicate that the cable is a loaded one), are made of the best selected ball furnaced "all wire" pig iron, specified to have a strength not less than 23 tons per square inch and well galvanised with zinc spelter. Experience has shown that iron of this type is less subject to corrosion than the homogeneous iron which was formerly used by the Post Office.

Each completed set of loading coils, with their insulated covering and before jointing into the cable, was subjected to an external hydraulic pressure of 15 cwt. per square inch for not less than half an hour without producing distortion or other injury. The cable was constructed by Messrs. Siemens Bros. in their works at Charlton, Woolwich.

Aërial land lines of 600 lbs. copper have been run from the respective landing points to Manchester and to Dublin in order to secure a high standard of speech on the circuits. A description of the laying of the cable will appear in our next issue. J. G. H.

---

## GHENT EXHIBITION.

AWARDS ACCORDED TO EXHIBITORS IN POST OFFICE COURT.

*Class* 15.—Scientific Instruments.

Gold Medal: Gell Telegraphic Appliances Syndicate.

*Class* 23.—Mechanical Production and Utilisation of Electricity.

Silver Medal: Sauvée & Co., Ltd., A.



Digitized by Google

*Class* 24.—Electro-Chemistry.

Grand Prix: Siemens Bros. & Co., Ltd.

*Class* 26.—Telegraphy and Telephony.

Grand Prix: General Post Office; Siemens Bros. & Co.; Western Electric Co.

Diploma of Honour: Gell Telegraphic Appliances, Ltd.; Sullivan, H. W.

Gold Medal: British Insulated and Helsby Cables, Ltd.; Burt, Boulton & Haywood, Ltd.; Lamson Pneumatic Co., Ltd.; Peel-Conner Telephone Works, Ltd.

Silver Medal: Gent. & Co., Ltd.; Oliver Typewriter Co., Ltd.

*Class* 27.—Miscellaneous Applications of Electricity.

Grand Prix: Siemens Bros. & Co., Ltd.

Gold Medal: Gent. & Co, Ltd.; Silent Electric Clock Co., Ltd.

*Class* 28.—Materials, Plant and Processes relating to Civil Engineering.

Gold Medal: Burt, Boulton & Haywood, Ltd.; Lamson Pneumatic Tube Co., Ltd.

*Class* 32.—Railway and Tramway Plant.

Silver Medal: Burt, Boulton & Haywood, Ltd.

*Class* 33.—Materials and Plant used in the Mercantile Marine.

*Hors Concours*: P. & O. Steamship Co.

Grand Prix: Oceanic Steam Navigation Co., Ltd.; Pacific Steam Navigation Co., Ltd.; Royal Mail Steam Packet Co.

Diploma of Honour: Orient Steam Navigation Co., Ltd.; Union Castle Mail Steamship Co., Ltd.

Gold Medal: City of Dublin Steam Packet Co.; British and African Steam Navigation Co., Ltd. (Elder, Dempster); Great Eastern Railway Co.; South Eastern and Chatham Railway Co.

*Class* 50.—Products of the Cultivation of Forests and of Forest Industries.

Diploma of Honour: Burt, Boulton & Haywood, Ltd.

*Class* 87.—Applied Chemistry and Pharmacy.

Silver Medal: Burt, Boulton & Haywood, Ltd.

The whole of the British exhibitors secured a total of 200 awards, of which the Post Office alone obtained 15·5 per cent.

During the month of October a number of technical officers from the various administrations in Europe visited the Post Office Court in connection with the reconstruction of some of their postal and telegraph appliances. Monsieur Hubar, the Directeur de Service des Postes, took particulars of the Department's latest



Digitized by Google

appliances for dealing with mails, whilst M. Pierre Pasquier, who, it is understood, made a special journey from China to Europe in connection with the equipment of a new line of railways in China with Morse apparatus, was directed to the Post Office Gallery.

The official closing day of the exhibition was fixed for November 3rd, and on this date a grand banquet and ball was given to the exhibitors and their assistants, in the Palais des Fêtes. The function, which was typically Continental, did not conclude until the early hours.

Owing to the great demand from the residents of Ghent and others to acquire the exhibits, the authorities decided to keep the Sections open until November 10th. Numerous applications were made to the officer-in-charge of the Post Office Gallery during this period with reference to the various exhibits.

At daybreak on the morning of the 11th an enormous army of housebreakers entered the grounds, and by noon, what had been a veritable fairyland became one huge collection of vans and packing-cases. Unfortunately, the authorities discontinued the supply of current to the grounds on this date, and, consequently, all work had to cease at dusk.

H. N.

# RULES AND REGULATIONS TO BE OBSERVED BY INSPECTORS IN THE SERVICE OF THE ELECTRIC TELEGRAPH COMPANY (1850).

[*In view of the revival of the title "Inspector" it is thought the following instruction on the duties of the class, issued by the Electric Telegraph Company in* 1850, *may not be without interest to the staff to-day.*]

## Duties of Inspectors.

1. You will be considered entirely *responsible* to the Company for the attention and vigilance of the men placed under you, and for the good working order of your District.

2. You will take care that each man *examines* his portion of line as frequently, and as carefully as required; and with this view, you will inspect each Note Book, and check the dates and signatures frequently, and will, also, take opportunities of *walking* over each portion of the lines, examining every part as minutely as the Linemen are directed to do.

3. You will *report* the result of such examination, and append



Digitized by Google

your recommendations with respect to any peculiar care and vigilance you have observed. You will on no account fail to report every fault and imperfection you detect.

4. You will, if possible, *walk* over some portion of your District *every week*, taking care so to arrange as that every portion may be subjected to your examination in turn. You will *test* each part as frequently as your other duties will allow, comparing the several results, so that you may know at all times the condition of every part of your line, and the effect of the works undertaken upon it. In these *examinations* you will look to every cone, clip, winder, joint, shackle, etc., and ascertain that all parts are clean, perfect and in good and safe working order.

5. You will see that the *store boxes* are kept in good order, and well supplied with all necessary tools and stores, and that *no waste*, or undue use of these takes place.

6. In the event of any *accident* occurring, you will take immediate steps to remedy the same, directing the Linemen as to the measures they are to adopt for its rectification; and, if necessary, you will proceed thither yourself, or provide additional *assistance*. With a view to enable you to prevent the recurrence of a similar fault, you will in all cases require a full *report* from the Lineman (in whose district the accident may occur) of the nature of the same, and of the means adopted to rectify it. You will transmit this with your Notes to this Office.

7. Should you find it desirable to *alter the usual Orders* of the Linemen owing to the existence of any undiscovered or unrectified fault, you will direct them in the morning before leaving their Stations as to their employment during the day.

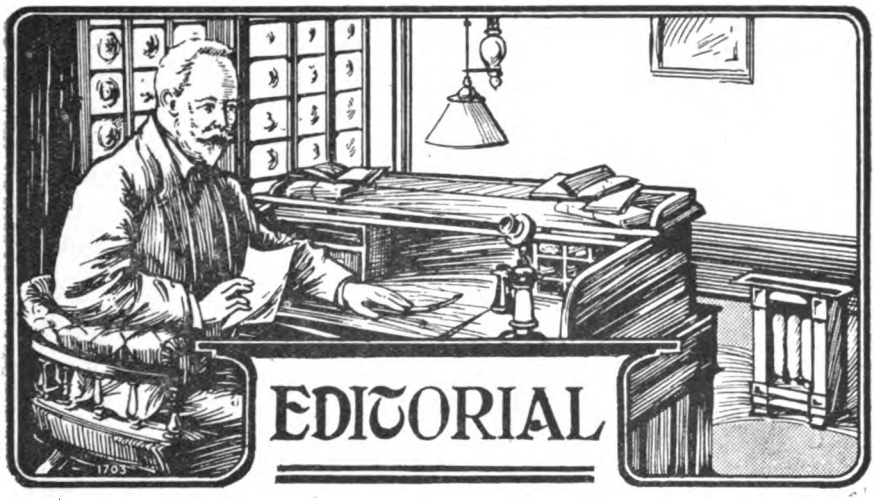
8. You will be required to take care that the *Stations* are so fitted as not to lead to any fault or interruption, and also that proper conveniences are afforded to the several Linemen for assisting in your *testing* of the different portions of the Line. The Stations and conveniences for testing are placed peculiarly under *your immediate charge*.

9. You will receive weekly a *return of work* from each of your Linemen. You will examine these, and forward them with your remarks, to this Office on each Saturday night.

10. You will be required to take care that, although all needful facilities are afforded to the Linemen, yet, that no fares are incurred unnecessarily, and also that no extra assistance is employed unless absolutely requisite.



Digitized by Google




## WORKMEN'S TECHNICAL CLASSES.

IT is with great satisfaction that we view the most recent development in the efforts to solve the problem of training the rapidly expanding body of workmen employed in the Engineering Department of the Post Office—namely, the establishment of special courses of study at various Polytechnic and Technical Institutes in London and the Provinces as the result of co-operation between the Post Office and the respective authorities.

For nearly twenty years past—since 1896, in fact, when the Telephone Trunk System was transferred to, and re-designed by, the Post Office—this problem has been one of the chief difficulties encountered in dealing with the enormous increase of electrical work, both in volume and in complexity. The expansion is due mainly, of course, to the advance of the telephone, but it must not be overlooked that the telegraph service also has contributed its quota in the shape, for example, of improved methods of working, such as the Central Battery System and the relayed and forked quadruplex, whilst among the miscellaneous items are goods and passenger lifts, letter-stamping machines, and synchronised clocks.

Looking back—sometimes a profitable course, even for the engineer—it is of interest to see that the first step towards enabling the executive staff to conform to the changing requirements took the shape of informal classes held on official premises, and, generally, after the engineer-teacher and the lineman-pupils had performed their respective duties for the day. At the same time, a number of the more advanced linemen and mechanics in the large towns attended the technological classes designed primarily to prepare



Digitized by Google

students for the examinations in Telegraphy and Telephony conducted by the City and Guilds of London Institute.

After a time, the individual efforts on the part of engineers lapsed, probably because the needs of the moment had been satisfied, but with the advent of the Post Office London Telephone System they were again in evidence, and in one instance, at least, on a more systematic basis—indeed, we cannot refrain from the thought that the germ of the present arrangements is to be found in the synopsis and notes of a series of lectures delivered gratuitously in a London office some eight years ago.

About the same time, schools for training youths in the jointing of underground cables were established in London and Birmingham as part of the official machinery, but the pressure of other matters operated to prevent the emergence of any definite scheme for covering the whole of the ground.

Two years ago, the approaching acquisition of the business of the National Telephone Company, under whose control had been established a system of correspondence classes for their staff, and the knowledge that increased activity in local telephone work would undoubtedly produce a general demand for more trained men, brought the question into renewed prominence, and, after the preparation of suitable syllabuses by the Engineer-in-Chief to the Post Office, thirteen classes were established last year in various parts of London, and one in each of twenty-one provincial towns, namely, Belfast, Birmingham, Bristol, Cambridge, Cardiff, Croydon, Dublin, Dundee, Exeter, Glasgow, Gloucester, Hull, Liverpool, Manchester, Newcastle, Newport, Nottingham, Reading, Sheffield, Swansea, and Tunbridge Wells.

The instruction was given free of charge on Post Office premises by selected engineering officers willing to undertake the work in return for small fees, and the necessary equipment was provided by the Post Office, which also defrayed the travelling expenses of men stationed away from, but within ten miles of, the point at which they attended. Attendance on the part of any man was, of course, voluntary.

After the commencement of the classes in London, negotiations took place between the educational authorities and the Post Office, with the result that at the beginning of the present session the whole of the London classes were transferred to the following centres of technical education, namely: Battersea Polytechnic; Chiswick Polytechnic; Goldsmiths' Institute, New Cross; Northampton Institute, Clerkenwell; Paddington Technical Institute; Regent Street Polytechnic; Tottenham Polytechnic; West Ham Municipal Technical Institute.

In a few provincial towns the arrangements in force last session



Digitized by Google

remain undisturbed for the present, but we understand that the principle adopted in London has been extended to some 52 towns in which there are educational institutions, and a total of 2300 students are taking advantage of the courses provided.

Briefly, the arrangements are that the Post Office pays the fees of the men attending (subject to refundment by the latter in certain circumstances), and the syllabuses have been drafted to meet the requirements of the Post Office; but, in all other respects, the normal organisation of each Institute comes into operation. In the main, the instruction continues to be given by the engineering officers previously in charge of the classes, their services having been retained by one or other of the governing bodies.

The advantages of this development are obvious: not only is the accommodation for the classes of a suitable character, but the whole environment must tend more to stimulate the interest of the men than could be hoped from the semi-official conditions which, in spite of the very best intentions, is all that the Post Office, working directly, can provide.

Those of our readers who have not the good fortune to be included in the Engineering Department of the Post Office may be inclined to wonder why the training which these classes are designed to provide cannot be afforded in the ordinary course of the men's daily work. The answer is that it can be afforded in that way, but only at the cost of many mistakes and a correspondingly long period of inefficiency—bad alike for the reputation of the Post Office, the characters of the men and the interests of the telephone public. The nature of their duties requires that the men shall work largely as individual units instead of being engaged in groups under the immediate control of a foreman as is the case with most analogous works, and although a preliminary training in general principles and many details is given, the actual conditions encountered in practice vary so greatly that much has to be left to the judgment and experience of the individual and his power to apply the knowledge he possesses. It is here that the sphere of the class is found, that is, in providing information which is such a combination of theoretical principles and practical directions as will enable an intelligent man to understand why he does those things which he knows are right, and thus to reason his way through a difficulty which he has not had to face previously. If the number of men affected were but small, it might be possible to provide this collective instruction as part of, and during, the ordinary working-day, until such time as each individual attained the desired standard; but under the most favourable conditions the objections to such an arrangement in the Engineering Department are very strong, and whilst the work and staff are expanding as rapidly as of late years they are insuperable.



Digitized by Google

It will be clear from what we have already said that the object of the training scheme is to secure skilled craftsmen—not workmen to whose practical attainments has been added a smattering of theoretical electrical knowledge; and we think it may be well here to give voice to a word of warning in regard to the inevitable tendency, as time goes on, to "raise the standard" of the instruction, either by failing to treat with the same completeness as formerly the most elementary portions of the work, or by endeavouring to compress within the limits of the respective courses advanced matter which has previously been excluded. The aim of each course throughout should be to provide for the men who are a little below rather than above the average; the latter, if they want more after having acquired all the benefit they can from the special classes, will find their way naturally to the more ambitious courses based on the examination syllabuses of the Board of Education and the City and Guilds of London Institute.

It would doubtless be of interest to some of our readers if we were to examine the arrangements described in the light of the history of the Trades and Crafts Guilds and of the apprenticeship system in the outside world; but on this occasion the usual considerations of space prevent—nevertheless, we would say that any contribution on that aspect of the matter will receive our most generous consideration.

## BOOK REVIEWS.

'The Economics of Telegraphs and Telephones,' by John Lee, M.A., Traffic Manager, G.P.O. (Pitman's Business Handbooks.) (Published by Sir Isaac Pitman & Sons, Amen Corner, E.C. Price 2*s.* 6*d.* net.)

Of text-books dealing with the technical developments of telegraph and telephone systems there is no end, but those dealing with the economics of the subject have neither been numerous nor exhaustive. Mr. Lee's excursion into this field is, therefore, a welcome one. It would be difficult to find anyone better qualified, alike by predilection, study, and experience, for the task he has set himself. The title he has chosen is probably the best obtainable, but it does not describe very precisely the purport of his book. He does not deal with such things as operating costs, message costs, or plant costs at all. Economics is, perhaps, best defined as *the science of management*, but the main theme of his treatise is outside the scope of such a definition. His prime object has obviously been to exhibit the importance of telegraphy and telephony as factors in the develop-



Digitized by Google

ment of modern industry, and in the building up of national and international social and trade relationship. These considerations are fundamental. They represent the *raison d'être* of the great telegraph and telephone services of the world, and they are matters of the greatest interest to every man engaged in these services who desires to view his profession in proper perspective, and to realise adequately how it reacts upon the world at large.

Mr. Lee has gathered his data from widely scattered sources, and has built it up in a bright and attractive manner, with much originality of thought and inference. The work is far from exhaustive, but it has the essential quality of suggestiveness, and few will read it without feeling that many pregnant little side-issues are presenting themselves for useful consideration.

Mr. Lee does not argue for state ownership of telegraphs and telephones, but he has much to say which clearly indicates that it is along these lines that his convictions lie. In the telephone service, at least, monopoly, with its unity of administration, is treated as an essential. His optimism in the matter of State services perhaps leads him to under-estimate the alternative which is so powerfully advocated by some of the leaders in the telephone world of the United States—the ideal that private ownership, starting with its immense advantages in the way of providing personal stimulus and direct interest in the efficiency and success of the organism as a whole, may have its evils neutralised by vesting the service in a great business corporation subject to the scrutiny and control of public authority in all matters where its interests may run counter to the interests of its *clientèle*. Such a system is on trial for its life in America, and Mr. Lee appears to anticipate that the ultimate verdict will be an adverse one.

Among the many points of interest which the book contains may be mentioned a brief history of the development of the telegraph and telephone in Europe and America, written mainly from the standpoint of the public; the manner in which some trades, such as the fish trade, have for many years used the telegraph in a thoroughly systematic way, while other trades, that might have derived equal profit from its aid, have consistently neglected it; the extent to which the spread of the idea of municipal telephones helped the Post Office to acquire the English trunk-lines from the National Telephone Company, and the subsequent complete collapse of the municipal idea; the growth of the trunk system represented by the difference between the purchase price in 1895 (£450,000) and its present capitalisation of six million pounds; the ethics and economics of the English telegraph rates for news; the effect of highly elaborated code-word systems in preventing the lowering of cable rates; the measure of dealings between nations obtainable from the statistics of the international telegraphing of money; the effect of the tele-



Digitized by Google

phone in facilitating the decentralisation of industry from urban localities, and the establishment of large factories in places where land is cheap and rates are low.

Regarding the purchase of the telegraph system of Great Britain in 1870, Mr. Lee remarks on the interesting fact that the price paid (£10,000,000) was only 25 per cent. lower than that paid for the very much more extensive and valuable system of the National Telephone Company in 1912. A more striking proof of the over-valuation of the telegraph system in 1870 could hardly be produced. Mr. Lee remarks that as a result of the recent telephone transfer the Post Office begins its management of telephones on the national scale with a financial foundation that does not cripple its enterprise, but he refrains from any exuberance regarding the reduction in the National Telephone Company's claim from twenty-one millions to twelve and a half millions. It is curious how little has been said of the fact that even with this reduction the Post Office paid several millions more for the system than it considered it to be worth!

Mention must be made of Mr. Lee's testimonial to the Post Office trunk service; he says: "The English long-distance telephone service is, without doubt, the best in the world for clearness of speech and moderateness of charge."

The book is one alike for those engaged in the provision and administration of communication services and for business men. The latter cannot fail to be edified by such passages as those on pages 59 and 60, in which the use made of the telephone by a great American insurance company is vividly described. Wide perusal of the work by the business community would go far towards engendering a feeling of sympathetic co-operation with the administration of the Post Office services, and such a result would probably be deemed by the author to be the fulfilment of his hopes.

T. F. P.

'Die Abhangigkeit des erfolgreichen Fernsprechanrufes von der Anzahl der Verbindungsorgane' ('The Dependence of the Attainable Number of Telephone Calls on the Number of Connecting Circuits'), by Dr. Ing. Freidrich Spiecker, Diplom-Ingenieur. (Published by Julius Springer, Berlin, 1913. 65 pp. Price 2 *m.* 40 pf. 11 in. by 8 in., paper covers.)

After reviewing formulæ used by the Western Electric Co. of America and the late National Telephone Co. for manual exchanges, also that of A. Campbell for automatic exchanges, and the theoretical work of Grinstedt on 'A Study of Telephone Traffic Problems,' 1907, the author concludes that the available formulæ are insufficient and in some cases inexact. (It is somewhat surprising that the review of previous work done is not more extensive, so as to



Digitized by Google

include, for example, the work done by the Copenhagen Telephone Co. on the same subject.) In any case the author undertook the working out afresh, on the theory of probability, of the most important problems which present themselves for solution, taking into account actual working conditions. The book under review is the result. In order to test the accuracy of the formulæ deduced, a series of experiments was made on the private automatic telephone system of the Allgemeinen Eliktrizitäts-Gesellschaft in November, 1912, and the results are compared with the formulæ previously deduced. Finally, the author gives formulæ which he considers most suitable for practical application.

In an appendix the complete data of a series of experimental trials are given and the results fully worked out.

The work should be very useful to traffic experts.

J. G. H.

'Dynamo and Motor Attendants and their Machines,' by Frank Broadbent, M.I.E.E. (Seventh edition. Rentell & Co. Price 1*s.* 6*d.* net.)

When a book reaches its seventh edition the reviewer's task is a happy one, particularly when, as in this case, the work bears ample evidence of the author's thorough grasp of his subject. As the title suggests, the book is essentially practical, and at every page the reader feels that he is being advised by one who has learnt in the hard school of experience.

The entire absence of mathematics, which is a great point in the favour of any book appealing to the practical man, is made possible by simple lucid methods of description, *e.g.* p. 140, action of auto-transformer, which, while only approximating to the true theory, are all that is required for a work making no pretence of being an examination text-book.

Chapter VII contains some good mechanical "tips," and the portions of Chapter IX dealing with sparking at commutators and heating of bearings should be read and re-read by every man in charge of electrical machinery.

By way of criticism we would suggest that in Chapter II the paragraph on "Direction of Current" and "Polarity of an Electro-magnet" should precede those on induced currents, and in applying Fleming's hand rule (figs. 55 and 56) those fingers should be taken, the names of which give helpful mnemonics: *First finger, Flux; thuMb, Motion; seCond finger, Current.*

The connections for synchronising alternators on p. 73 would be more up-to-date if the plug-holes were on separate generator panels connected by synchronising bus-bars, and there is certainly



Digitized by Google

no justification for implying on p. 74 that synchroscopes are in the experimental stage.

There is much repetition throughout the book, but this is an advantage rather than otherwise, as it makes each section very complete and facilitates quick reference.

The many illustrations and diagrams are of the highest order, and the publishers in providing clean print and a good paper have maintained the high standard of excellence set by the author.

P. D.

'Electric Circuit Theory and Calculations,' by W. Perren Maycock, M.I.E.E. (Whittaker & Co. Price 3*s.* 6*d.*)

Mr. Maycock's books now run into a very considerable list, and represent some excellent work in the interests of students and of those engaged in the practical side of electric lighting, motors, etc. This, his latest book, deals very simply and thoroughly with the quantities involved in the daily work of the engineer, contractor, and wireman. Commencing with the fundamental rules as to current, resistance, etc., it leads naturally on to installation work, power required, permissible drop, etc., and thence to efficiency of lamps, dynamos and motors. Every section is illustrated by a wealth of worked-out examples. Ordinary and three-wire D.C. systems, single and polyphase A.C. systems are then dealt with, as well as light, illumination, fire rules, etc. To a steady worker the book is an excellent guide, and the systematic working-out of the examples given should ensure a firmer grip of the principles involved.

The book also contains a section devoted entirely to the arithmetic called for in making the calculations. The inclusion of such a section will be, to many, of doubtful propriety. To say that a book on electrical matters is not the vehicle for teaching arithmetic is a criticism very easily made, but we think the author is well advised in including it. His reasons for so doing are substantial and will be endorsed by many teachers, who find in their classes a considerable leaven of students, eager and painstaking, whose school-days are far behind, who are seriously hindered by a "weakness in figures." The book deserves, and should have, a large sale.

'Handbook of Technical Instruction for Wireless Telegraphists,' by J. C. Hawkhead. (Published by the Marconi Press Agency, of Marconi House, Strand, London, W.C. 3*s.* 6*d.* net.)

This course of instruction has been arranged so that the diligent reader who has gone carefully through it might be qualified to sit for the Postmaster-General's examination for wireless telegraphists. The book will be found extremely useful to the large and increasing number of amateurs now interested in wireless telegraphy. The



Digitized by Google

author has had practical experience in the operation and construction of all classes of wireless apparatus and stations and the text-book embodies this experience. The numerous illustrations of apparatus and diagrams form a useful feature. The instruction begins with a good groundwork in the fundamental principles of electrical science, and carries the student forward to the application of those principles to up-to-date wireless practice. The telegraphist who in the course of his manipulative training masters the contents of the volume will be a man capable of maintaining as well as working the apparatus.

## HEADQUARTERS NOTES.

SINCE the last issue of the JOURNAL, orders have been placed for the equipment of new C.B. Exchanges at—

| | |
|---|---|
| Cleckheaton | 360 lines |
| Greenwich | 1600 ,, |
| Lowestoft | 480 ,, |
| Romford | 360 ,, |
| Smethwick | 300 ,, |

Orders have also been placed for extending the existing equipments at—

| | |
|---|---|
| Altrincham | 300 lines |
| Chester | 840 ,, |
| Worcester | 320 ,, |

Installation of C.B. equipment has been commenced at—

| | |
|---|---|
| Edinburgh | Trunk extension |
| Harrod's Private Branch Exchange Extension | 180 lines |
| Shipley Extension | 180 ,, |
| Purley New Exchange | 1200 ,, |
| Tunbridge Wells New Exchange | 1200 ,, |

The installation of the following equipments has been completed:

| | |
|---|---|
| Barnsley New Exchange | 480 lines |
| Kilmarnock New Exchange | 440 ,, |
| Port Talbot New Exchange | 300 ,, |
| Avenue Extension | 420 ,, |
| Hop Extension | 1720 ,, |
| Ibrox Extension | 120 ,, |
| Langside Extension | 100 ,, |
| Lee Green Extension | 180 ,, |
| Regent Extension | 5700 ,, |



Digitized by Google

## Automatic Telephone Development.

Orders have been placed for the following exchange equipments:

| | | |
|---|---|---|
| Newport (Mon.) | 1800 lines | Automatic Tele. Mfg. Co. |
| Portsmouth | 5000 ,, | ,, ,, |
| Accrington | 700 ,, | ,, ,, |
| Paisley | 1100 ,, | ,, ,, |
| Chepstow | 65 ,, | ,, ,, |
| Leeds | 6800 ,, | ,, ,, |
| Darlington | 800 ,, | Western Electric Co. |
| Dudley | 500 ,, | ,, ,, |
| Grimsby | 1300 ,, | Siemens Bros. & Co., Ltd. |
| Stockport | 950 ,, | ,, ,, |

An order has been placed with Messrs. Siemens Bros. for apparatus for the automatic selection of the "B" operator on position 132 at the Central Exchange, London, which is a "split-order-wire" position.

An extension of the official switch by 150 lines has also been arranged for.

## C.B. Manual Exchanges.

| New Exchanges opened. | Date. | No. of subscribers working at opening. |
|---|---|---|
| Mansfield | September 20th | 328 |
| Barnsley | November 29th | 410 |
| Victoria (London) (advance portion) | October 3rd | 42 |

## Relief Underground Scheme for Exchange Subscribers.

In order to cope with the rapid development in the requirements of subscribers' service, also to relieve heavy congestion in existing overhead and underground plant, special arrangements have been made under which contractors will be empowered to carry out underground works to completion on an annual contract basis, *e.g.* the contractors will lay the pipes or ducts, also provide, draw in, and joint the cables.

The various engineering districts have been grouped so as to form seven contractors' areas, and the particulars shown below indicate the method of grouping, also the firms with whom the contracts have been placed for each of the areas:

| Section. | Districts. | Contractor. |
|---|---|---|
| 1 | Scotland East and Scotland West | Messrs. Henleys. |
| 2 | Ireland | The British Insulated and Helsby Co. |
| 3 | Northern and North-Eastern | Messrs. Siemens. |
| 4 | North-Western and South Lancashire | The British Insulated and Helsby Co. |
| 5 | North Wales and North Midland | Western Electric Co. |
| 6 | South Wales, South-Western, and South Midland | Messrs. Callender's Cable and Construction Co. |
| 7 | Eastern, South-Eastern, and London | Messrs. Callender's Cable and Construction Co. |



Digitized by Google

At the time of writing these notes, approximately 140 schemes in different parts of the country have been authorised, and a large number of schemes are under consideration for authorisation, on the special contract basis.

The responsibility and pressure in the Engineering Department could scarcely find better expression than in the activities of its popular chief, Mr. Slingo, who took up the reins of this great Department at a period when it was well before the notice of the public—that is to say, at the transfer of the National Telephone Company's plant to Post Office control and during the inventory and valuation of that plant. The leading part which Mr. Slingo played in the Telephone Arbitration proceedings last year is well known to our readers, as are also Mr. Slingo's appearances before the Holt Parliamentary Committee and the Parliamentary Committees dealing with the Post Office (London) Railway Scheme. In these days the calls upon the Engineer-in-Chief's time are not restricted to Post Office work proper, and the inclusion of Mr. Slingo's name in the list of members of the two new Government Committees mentioned hereunder will doubtless cause no surprise.

### Electrical Explosions Committee.

The Board of Trade has appointed the following gentlemen, viz. Sir T. Edward Thorpe, C.B., F.R.S. (Chairman), Mr. Robert Nelson, Mr. W. Slingo, Mr. James Swinburne, F.R.S., and Mr. Alexander P. Trotter, to be a Committee to consider the causes of explosions which have occurred in connection with the use of bitumen in laying cable-mains at Nottingham, Hebburn, and elsewhere, and to report as to any steps which should be taken to prevent explosions in future from the use of this or similar substances.

### Wireless Telegraphy Research.—New Government Committee.

The Postmaster-General has, we are officially informed, appointed a committee "to consider how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with any ordinary telegraphy and telephony." The members of the committee are as follows:

The Right Hon. C. E. H. Hobhouse, M.P. (chairman), Chancellor of the Duchy of Lancaster. The Right Hon. Lord Parker of Waddington. (In January last, as Mr. Justice Parker, he was appointed chairman of the expert committee which investigated the



Digitized by Google

merits of the various systems of long-distance wireless telegraphy. This inquiry was made on the recommendation of the Select Committee of the House of Commons on the Marconi contract. In February he became a Lord of Appeal.) Sir Joseph Larmor, M.P., F.R.S., secretary of the Royal Society, 1901–12. Sir Henry Norman, M.P., chairman of the War Office Committee on Wireless Telegraphy, 1912. Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, and past-president of the Institution of Electrical Engineers. Mr. W. Duddell, M.I.E.E., F.R.S., past-president of the Röntgen Society, and president of the Institution of Electrical Engineers. Mr. R. Wilkins, C.B. Rear-Admiral E. F. B. Charlton, R.N. Commander J. K. Im Thurn, R.N. Sir Alexander King, K.C.B., secretary to the General Post Office. Mr. W. Slingo. Commander F. Loring, R.N., Inspector of Wireless Telegraphy to the Post Office. Major the Hon. H. C. Guest, M.P.

The office of the committee is at 6, Catherine Street, Strand.

—(*'The Standard,' Monday, November 10th*, 1913.)

### Major W. A. J. O'Meara, C.M.G., Ret. R.E., Barrister-at-Law.

Just before going to press we learn that Major O'Meara, formerly Engineer-in-Chief of the Post Office, has retired from the position of Engineering Special Commissioner, a position which he held from March 1st, 1912, until November 27th, 1913.

An outline of the career, both military and civil, of this distinguished public servant appeared in the Journal for April, 1912, and a few details of his activities since he relinquished the position of Engineer-in-Chief were furnished in our issue of April, 1913.

It is understood that Major O'Meara proposes to practise as a barrister, and it may be confidently anticipated that with his wide experience in different parts of the world as an organiser and administrator, his high standing in the engineering profession, and his outstanding ability and energy, he will attain a position of eminence in the legal profession.

---

## LONDON ENGINEERING DISTRICT NOTES.

### New Telephone Lines.

During the thirteen weeks ended October 28th, 1913, 4081 direct Exchange lines, 195 external extensions and 2604 internal extensions were completed. In the same period 2858 Exchange lines, 180 external extensions and 1521 internal extensions were



Digitized by Google

recovered, making a net increase of 1223 direct Exchange lines, 15 external extensions and 1083 internal extensions.

This work resulted in a net increase in the number of telephone stations in the London Engineering District of 2483 stations for the quarter, and it will be seen that this means an addition of one telephone station for every fifteen minutes of the working day.

In the same period 693 removals of Exchange circuits were carried out for subscribers.

## Exchange Departments.

*Victoria.*—An advance equipment of 400 lines was brought into use on October 3rd. The main transfer will be made early in the new year.

*Museum.*—10,000 lines. Approaching completion.

*North Exchange.*—Extension for 1000 lines. The work has been delayed by difficulties in connection with the building accommodation.

*Toll Exchange.*—The work in connection with the provision of fifty additional positions is approaching completion.

*Harrod's Private Branch Exchange.*—Increased accommodation for 180 lines, three additional positions and renewal of power plant. The work was completed in readiness for Christmas pressure.

## Technical Classes.

Efforts which have been made in previous years to improve the technical education of the Department's junior workmen by providing classes on Post Office premises have not been quite as successful as was desired, mainly owing to the unsuitability of the premises which had to be used and the difficulty of obtaining adequate teaching equipment. Some few months ago negotiations were opened with the London County Council and the other Metropolitan County Councils, and the councils have undertaken to provide classes at various technical institutes to work through a syllabus which has been prepared by the Department. A two years' course has been arranged, the first year consisting of lectures and laboratory work in technical electricity, and practical work in connection with wiring and instruments, while the second year continues the practical work, the student in addition taking either telegraphy or telephony (C. and G. 1st Grade) and technical arithmetic. Each student attends two nights per week. The Department is defraying the fees, and also paying the travelling fares of students up to a distance of ten miles. The student, on the other hand, in the event of his failing to obtain a certificate or to make 80 per cent. of the attendances, will have to refund the amount paid by the Department, which will not exceed 10*s*. The Department has under-



Digitized by Google

taken to enrol the students, and the institutes have undertaken to provide for the Department monthly reports of the students' work and attendances. To judge from the number of students who have enrolled, the new departure is popular; over 1000 men out of a staff of 4000 are attending the classes.

### New Offices for the Superintending Engineer's Staff.

When the concentration of the London staff into one engineering district was carried out on October 1st, 1912, it was found that it was not possible to accommodate the whole of the Superintending Engineer's clerical staff in any of the existing buildings, and the awkward expedient had to be resorted to of subdividing the staff, accommodating the Engineering and Administrative sections at Denman Street, London Bridge, and the Accounting and Wayleave sections at Wandsworth, in the buildings which had previously been used by the South Metropolitan District. The provision of a new building capable of accommodating the combined staff, some 350 in number, was at once taken up, and a site is available adjoining the present Denman Street building. Treasury authority has been obtained for a building 215 ft. long by 45 ft. wide, which will consist of six floors. Unfortunately, however, difficulty has been encountered in obtaining a good foundation, and it is found that it will be necessary to undertake additional expenditure for the provision of a sub-basement. It is hoped that this will not unduly delay the completion of the work, because the present conditions make difficult the smooth working of the Metropolitan District. The addition of the sub-basement will make seven floors. Two lifts will be provided, one for passengers and one for stores.

### Metropolitan Power District.

South-Western District Office Alterations.—The old lighting installation of approximately 1000 points on the individual lighting system has been replaced by a new installation of general lighting comprising about 750 points. Owing to the height of the ceilings being insufficient to allow of the use of 3/100 c.p. clusters, units of 3/50 c.p. have been utilised in the new installation. Practically the whole work was carried out whilst the ordinary postal work was in progress, but a considerable amount of night work was necessarily involved to avoid inconvenience.

The old switchboard has been replaced by a modern board, provision being made for separately metering the energy consumed by the lifts, lighting and conveyors, etc., respectively. The final change-over to this board was effected on Sunday, October 26th, last.

Four new electrically driven lifts and three conveyors have also been installed.



Digitized by Google

At the recent Motor Show held at Olympia, the following telephone circuits were provided: 179 Exchange lines; 4 private wires; 4 telegraph circuits, in addition to the 15 permanent circuits.

Although the orders for many of these lines were not received until the day preceding the Show, all lines were completed and working before the opening.

---

## SOME PERSONAL REMINISCENCES OF SIR WILLIAM HENRY PREECE, K.C.B.

By H. R. KEMPE.

ALTHOUGH my personal acquaintance with Sir W. H. Preece does not date further back than 1870—the year in which I had the good fortune to enter the Postal Telegraph Service—I had knowledge of the existence of such a person as Mr. Preece (as he then was) through reading with great interest a short series of articles on "Railway Telegraphs" written by him, which appeared in 'The Electrician' (the precursor of the present journal of that name) of 1862.

On the subject of railway telegraphs Mr. Preece was, even at that comparatively early date, an expert, and, indeed, to him is due the credit of having done more to popularise block-signalling on railways than any other engineer. In 1862 the London and South-Western Railway completed its connection between the Exeter Queen Street and the St. David's stations by means of a somewhat unusually steep incline. Block-signals were required to work it. To meet this demand Mr. Preece invented his system, the characteristic of which is, independent of its electrical advantages, its assimilation in form and mode of working to the outdoor form of signals in use for the guidance of the engine-driver; this system was in due course fully developed and adopted over the whole of the London and South-Western Railway and also on other railways.

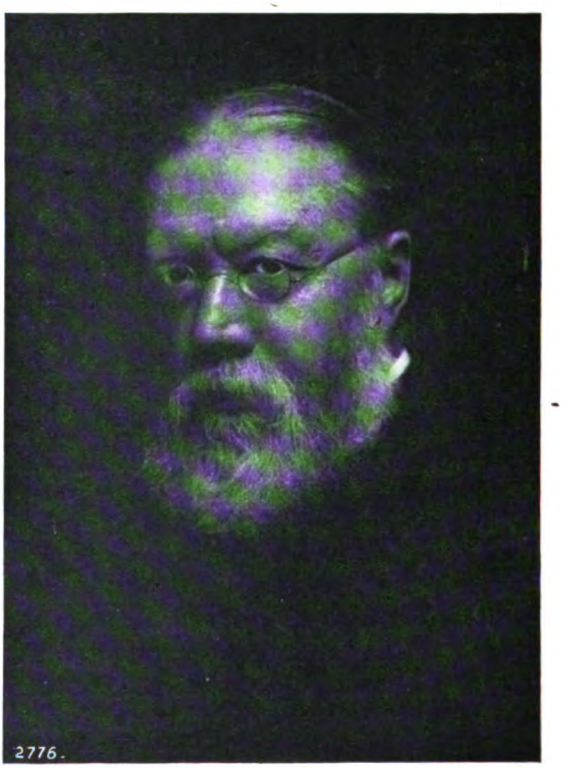
Under Mr. Preece's administration not only the electrical block-signal system, but also the ordinary telegraph system on the railway, in connection with the Electric and International Telegraph Company, was carried on, and as a natural consequence, on the transfer of the various telegraph systems to the State, Mr. Preece was selected for an important position under the new State administration, this position being that of Divisional Engineer of the Southern Division, which included the whole of the south of England (except that portion which was then worked by the R.Es.) and also South Wales, the headquarters being at Southampton.

It was shortly after this arrangement had been made that I had the honour (in 1870) of coming on the staff of Mr. Preece, somewhat



Digitized by Google

unexpectedly, and without my knowing that Mr. Preece (whom I had always associated purely in connection with railway matters) was a Post Office official. From the day I joined the Department at Southampton up to the day that Mr. Preece retired from the service, my association with him, as his personal assistant, was unbroken and of a most pleasing character. I will not enlarge upon his personal kindness to me, I say all if I say that I can never forget it. Extraordinarily energetic, a fact partly due to his physical build,




Mr. Preece was perpetually and systematically at work. In the earlier part of his career he would take but four or five hours of sleep; waking up in the morning at four o'clock and sitting up in bed he would set to work jotting down or arranging notes on various electrical subjects.

He was very strong on the subject of the technical education of the members of his staff, never failing to impress upon them the necessity of doing all they could to educate themselves by reading and by attendance at scientific lectures. He was insistent upon the advisability of the study of the higher branches of mathematics, pointing out that it was quite possible for anyone with quite ordinary



Digitized by Google

ability to obtain a considerable knowledge of these if the subjects were tackled fearlessly. Fully appreciating the advantage of a mathematical knowledge, Mr. Preece was not an expert mathematician himself, though he fully understood the principles involved; in fact, a thorough and quick grasp of the bearing of all scientific matters was one of his characteristics. He never lost an opportunity of giving information on, and taking full notes in reference to, current scientific matters, and any new electrical discovery, announced in any of the scientific papers, had to be verified, when possible, by a repetition of the experiments described, all hands on his staff being requisitioned for the purpose.

Probably the first time Mr. Preece came into prominent public notice was on the occasion of a *soirée* given at the Royal Albert Hall on July 18th, 1871, on which occasion he gave a lecture before a large audience on the subject of "Telegraphy: Its Rise and Progress in England." The necessity of "self-assertiveness" was a thing which Mr. Preece was fully alive to, and it is certain that he deliberately (and most effectually) worked with this idea in his mind; to say that he was ambitious of fame (using the word ambitious in its best sense) is only to state a fact, and he succeeded in obtaining it. He used to tell me in the earlier days of my acquaintance with him that he had two ambitions—one was to lecture at the Royal Institution, and the other to become an F.R.S. These ambitions were fulfilled in due course: he lectured on three occasions at the Friday evening lectures of the R.I., first, on "The Inventions of Sir Charles Wheatstone," secondly, on "Railway Block Signalling," and thirdly, on "The Telephone." His lectures and papers elsewhere are too numerous to detail. They were always given in the happiest manner, and were excellent, both as regards composition and delivery. He had apparently no nerves, though he used to assure me that he was always in a state of great trepidation before commencing to speak.

As an administrator at the Post Office Mr. Preece was great, his strong personality overcoming numerous official obstacles, and he was highly sympathetic with the operating staff in regard to their attempts to improve their position as regards pay, etc.

When the electric light boom commenced, Mr. Preece at once threw himself with all his energy into the movement, and having once obtained a grasp of the subject, both from an engineering and commercial point of view, he maintained a lead. He was one of the first to have a private electric light installation (at his Wimbledon residence), and he took great credit for having arranged for his gardener to run the same, so much so in fact that *le jardinier de M. Preece* was often referred to in continental journals. That Mr. Preece was a "showman" is undeniable, but he was not at



Digitized by Google

all so in any invidious sense; he always knew thoroughly well what he was talking about, and he did that talking in a most taking way, so that it was always a great pleasure to listen to him, whether the subject were scientific or social.

By the death of Sir William Preece one more of the very few remaining links which have connected the past of telegraphy with the present is gone, and the world is markedly poorer than it was.

[*We are indebted to Messrs. Histed, Baker Street, W., for permission to reproduce the photograph accompanying this memoir.*]

## Funeral at Carnarvon.

There was a large assemblage of mourners at the funeral of Sir W. H. Preece, K.C.B., which took place at Carnarvon on Tuesday, November 11th, the funeral service being conducted in Lanbebling Church.

The chief mourners were: Mr. A. H. Preece, Mr. P. J. Preece, and Mr. F. H. Preece (sons); Mrs. David Moseley, Miss M. F. Preece, and Miss Amy Preece (daughters); Mr. J. R. Preece, C.M.G. (only surviving brother of the deceased); Mrs. Llewelyn Preece (wife of deceased's eldest son, who was unable to attend owing to illness); Mr. David Moseley (son-in-law); Major C. J. Eccles, 16th Lancers (nephew); Mr. E. E. Eccles (nephew); Mr. G. F. Preece (nephew); Mr. J. H. Woodward (representing Messrs. Preece, Cardew and Snell); Nurse Bettany; maids of Penrhos; Dr. Lloyd Roberts (medical attendant).

The members of the Carnarvon Town Council were present, in their robes, and representatives of the Carnarvon Harbour Trust. A number of wreaths from numerous friends and acquaintances were received together with letters and telegrams of sympathy.

A memorial service was held at St. Margaret's, Westminster, at noon on Tuesday; there was a large congregation. Representatives of all the great scientific institutions and public departments were present.

Preaching at the morning service at Christ Church, Carnarvon, on Sunday, the Vicar (the Rev. J. Wynne Jones) said that the remains of the late Sir. W. H. Preece would on Tuesday be laid to rest within sight of the great wireless installation to which his life work contributed so much. Though he was absent from the town for many years, Carnarvon never faded from his heart and he never forgot one old friend, however humble his circumstances. The thought of God was always present to him. A favourite passage often quoted by him was from Job, "Canst thou send out the lightnings that they may go and say unto thee, 'Here we are?'" and his referring of his electricity work to this was characteristic of the attitude of his mind throughout. To him science and religion were one. There



Digitized by Google

was nothing more striking than the tremendous sacrifice made by men of science. Science seemed sometimes to teach sacrifice and unselfishness certainly better than any narrow form of religion. The greatest benefactor of Wales at the present moment would be a theologian with half the brains of the late Sir William Preece, who would teach us that death was not the end of all things.

The ex-Mayor of Carnarvon (Mr. Newton), presiding at the opening proceedings of the election of Mayor on Monday, dwelt upon the great loss the town had sustained by the death of Sir William Preece. The late Sir William, he said, was possessed of characteristics which were only too rare in the present day. When in 1889 he retired from his public appointment with his honours thick upon him, there was no honour which he appreciated more than that of being made the first honorary freeman of his native town, for which he had the deepest affection.

## DEATH OF SIR ROBERT HUNTER, K.C.B.

It is with profound regret that we record the death of Sir Robert Hunter, K.C.B., which took place at his residence at Haslemere on November 6th. Only two weeks previously Sir Robert had been at the General Post Office clearing up preparatory to taking his final departure from his room there which had been the scene of so much of his activities. He was suddenly taken ill on reaching home, and breathed his last within such a short time of his official retirement.

Undoubtedly his death was accelerated by the serious inroads which he had made upon his strength during the last two years in conducting the strenuous fight with the National Telephone Company over the price to be paid by the Government for that Company's system.

He was spared to see that gigantic arbitration brought to a successful issue, but the strain left him unable to struggle with the illness which overtook him and robbed him of the well-earned ease which he was on the eve of enjoying.

The funeral took place at Haslemere on November 10th, and the service at the Parish Church there was very numerously attended by officials of the Post Office and of other Government Offices and by representatives of the numerous Public Societies and Institutions with which Sir Robert was intimately associated.

Simultaneously with this service a memorial service was held at Christ Church, Newgate Street. Among the crowded congregation were the Postmaster-General, the Attorney-General, and the heads of almost all the Post Office departments who had been unable to go to Haslemere.



Digitized by Google

The following notes had been prepared for insertion in this issue of the JOURNAL before the lamented death took place, and it may not be out of place to record them now, as they would have appeared had the sad event not happened:

Sir Robert came to the Post Office early in 1882, and after thirty-one years of official life, retired from the service on the 31st of July last at the age of sixty-nine, having been specially retained in order that he might conduct, on behalf of the Post Office, the

purchase from the National Telephone Company of its plant, property and assets.

Sir Robert was always far more than a legal adviser to a particular Government Department. He looked at the questions which came before him from a broad point of view, and always had in mind the fact that the interests of the Crown were involved as opposed to those of the subject. His great ability soon made him a man to be consulted by other Government departments on questions where Crown rights were concerned, and his advice was always as readily given as it was sought. It was often a matter of wonder how he found time and energy to advise on such a diversity of questions.



Digitized by Google

As a defender of prerogatives of the Crown Sir Robert had few equals.

At the Post Office no big questions of policy were decided without Sir Robert being consulted, and so highly were his advice and assistance valued from an administrative point of view that he was made a member of many departmental and inter-departmental committees, *e.g.* the Postage Rates Committee and the Landing Rights Committee, while he was Chairman of the Committee which revised and incidentally made useful and understandable the 'Post Office Guide.'

On many occasions he was called upon to give evidence before Parliamentary committees and to state the views of the Post Office on questions of policy as well as on Post Office law.

As Solicitor to the Post Office, Sir Robert had perhaps a larger range of subjects to deal with than any officer in the service except the Secretary himself. Apart from the many questions arising in connection with telegraph, telephone and wireless matters, he had to deal with a multiplicity of questions affecting the Post Office in its original capacity as carrier of the correspondence of the Nation, the Savings Bank, Money Order and Postal Order Departments; he closely watched the interests of the Post Office in relation to Parliamentary Bills (both public and private) introduced each Session. He always jealously guarded the monopoly of the Postmaster-General from encroachment, fought big fights in the courts with railway companies on the question of the amount to be paid to them for carrying the mails; was always ready to help in the development of Savings Bank facilities and all other services of the Post Office for the benefit of the public.

One of the most useful works undertaken by Sir Robert was the consolidation of the many Acts under which the Postmaster-General derived his powers in relation to the conduct of the postal service. This was indeed a labour of years, and involved the codification of no less than thirty-five Acts of Parliament ranging from the year 1710. It was undoubtedly largely if not entirely due to his energies that the Acts were at last consolidated in the Post Office Act of 1908.

But it was in connection with the wayleave rights of the Post Office under the Telegraph Acts that Sir Robert came in close touch with the Engineering Department most frequently. The many questions affecting the telegraph wayleave relations of the Post Office with railway and canal companies and with the road authorities throughout the country always received his most careful attention. The preservation of amicable relations with railway companies, whilst maintaining the statutory rights of the Postmaster-General on their various systems, required much tact, and it was largely due to Sir Robert that the railway companies some years ago



Digitized by Google

made agreements with the Post Office whereby they gave up their right of sending an unlimited number of free telegrams on their own business over the State telegraph lines. This arrangement, which was commonly known as the commutation of the railway free message privilege, resulted in an enormous reduction of the number of free messages sent annually by railway companies, and, of course, in a consequent saving of expense to the Department.

From the very outset of his career at the Post Office to the day of his retirement Sir Robert was in close touch with the policy of the Government in relation to the National Telephone Company. He drafted the important agreements between the Postmaster-General and the Company, notably those for the transfer to the State of the trunk lines, the agreement for intercommunication, etc., in London (when the Post Office commenced to construct a rival telephone system), and the agreement for the purchase of the whole of the Company's system under which the recent arbitration proceedings were conducted.

It will doubtless be in connection with the purchase of the National Telephone Company's system that Sir Robert Hunter's name will be associated with the history of the Post Office for all time.

A very able account of the arbitration proceedings appeared in the last issue of the JOURNAL; it is therefore unnecessary to make any further detailed reference to those proceedings here. Suffice it to say that Sir Robert was the man who directed the operations of the Post Office throughout. For the last three years he devoted the whole of his time to the advancement of the Post Office interest in this arbitration; day after day he worked hard and long in order to secure that the State should not pay too high a price for the plant which it was purchasing. How successfully he laboured can best be seen from a comparison of the amount finally awarded by the Court, viz. £12,515,264, with the amount originally claimed by the Company, viz. £20,924,700.

Outside the Post Office Sir Robert was well known as a champion of the rights of the public in respect of common lands. He was for many years Honorary Solicitor to the Commons Preservation Society and later one of its most enthusiastic and hard-working members. He was also Chairman of the Executive Committee of the National Trust for places of historic interest and natural beauty. In one or other capacity he was mainly instrumental in preserving for the public for all time many beautiful tracts of country, notably Epping Forest and the Devil's Punch Bowl, Hindhead. His loss to these societies will be as severely felt as it will to the Post Office.

[*The photograph of Sir Robert was prepared from a block kindly lent us by the Editor of "St. Martin's-le-Grand."*]



Digitized by Google

# MR. C. T. FLEETWOOD.

MR. C. T. FLEETWOOD, a prominent figure in the official telegraph life of London for many years before he retired in 1902, died at his residence in North Finchley on November 28th in his seventy-seventh year. For the last few years his speech had become noticeably slower, but in other respects he retained remarkable health and vigour until a few weeks ago, when acute paralysis gradually developed.

Born April 23rd, 1837, Mr. Fleetwood entered the service of the Electric and International Telegraph Co. on December 8th, 1854, and came over to the Post Office with the transfer of the telegraphs to the State in 1870. He was appointed Superintendent Lower Section on January 29th, 1870; Assistant Superintending Engineer on June 17th, 1887; and Superintending Engineer on June 26th, 1894. He retired from active service on April 23rd, 1902, but only to continue with much enthusiasm his favourite experimental work in electrical science.

Perhaps the earliest work of unusual magnitude undertaken by Mr. Fleetwood for the Post Office was supervising the wiring of the new Central Telegraph Office in St. Martin's-le-Grand in preparation for the transfer from the Lothbury Office. It is only a few months ago that Mr. Fleetwood in conversation recalled this incident in his life, and explained that Mr. R. S. Culley sent for him specially and offered the supervision of the work to him. He remembered this work as calling for the most strenuous effort from everyone connected with it in order to have the new office ready in time.

Mr. Fleetwood was intensely interested in the advent both of the telephone and of wireless telegraphy in this country. When he saw the pair of telephones brought over from America by the late Sir William Preece he immediately embarked upon a series of experiments to ascertain the best resistance to wind the bobbins. He related with pleasure the profound astonishment which his first pair of telephones created amongst his friends, and particularly the effect upon the Editor of the 'Times,' with whom he was on very friendly terms, and who, when he learned of Mr. Fleetwood's experiments, invited him to give a demonstration. Again, the first sight of the Marconi coherer started him on the quest of best dimensions. Most of us have seen the gigantic coherer which he ultimately constructed for popular lecture purposes.

After retirement Mr. Fleetwood retained his interest unabated in telegraphic and telephonic matters, and spent many hours with his Geissler tubes and wireless telegraph installation. As an indication of the spirit which carried him successfully through life, it may be mentioned that he began in his seventy-seventh year to practise with



Digitized by Google

the enthusiasm of youth the Morse key in order to improve his reception and transmission of wireless signals. He took great pleasure in his almost daily habit of attending in his wireless shed after breakfast to take time from Paris and find the "tune" on his home-made "tuner" of the numerous stations he "picked up." It may be said that Mr. Fleetwood was not satisfied with ordinary efficiency in his wireless installation. He worked to make it as good as it could be made, and he exercised his love for winding and re-winding his "tuners" and altering his "aërial" until he obtained the improvements desired. But these were Mr. Fleetwood's recreations. His retirement did not terminate his social and religious activities. He remained until the end an earnest Christian worker and an active member of the Wesleyan Church in Finchley. The Engineer-in-Chief's headquarters staff, the clerical force of the Metropolitan District, the C.T.O. mechanics and the Metropolitan linemen sent representatives and floral tributes to the funeral service, which was largely attended by Mr. Fleetwood's numerous friends.

# INSTITUTION NOTES.

## COUNCIL MEETINGS.

A MEETING of the Council was held at the Institution of Electrical Engineers, Victoria Embankment, on October 7th, 1913.

Mr. J. Sinnott (in the absence of Mr. W. Noble) presided.

The Secretary read a letter from Mr. A. Moir, Chairman of the Telephone and Telegraph Society of London, in reply to a communication from the Council, in which it was suggested—(1) That the Telephone Society and the Institution of Post Office Electrical Engineers should confine themselves to Traffic and Engineering matters respectively. (2) That the members of the former should be allowed to attend the meetings of the latter, and *vice versâ*.

Mr. Moir stated that the Telephone and Telegraph Society were fully in agreement with the Council that the presentation of papers to one Society which were more properly suitable to the other should, as far as possible, be avoided. Also it was agreed that members of the Institution should be allowed to attend the meetings of the Society.

### PROPOSED ALTERATION OF THE CONSTITUTION OF THE COUNCIL.

With further reference to the proposal of the London Centre, the Chairman of the Committee reminded the Council that in effect the suggestion put forward by the London Centre was that the Council, composed of London and provincial members, should control the London Centre.

The Council adhered to their decision not to adopt the recommendations made by the London Centre, but as regards the method of appointing the Secretary the members of Council were asked to ascertain as far as possible the views of their constituents, and the matter was postponed until the next meeting.

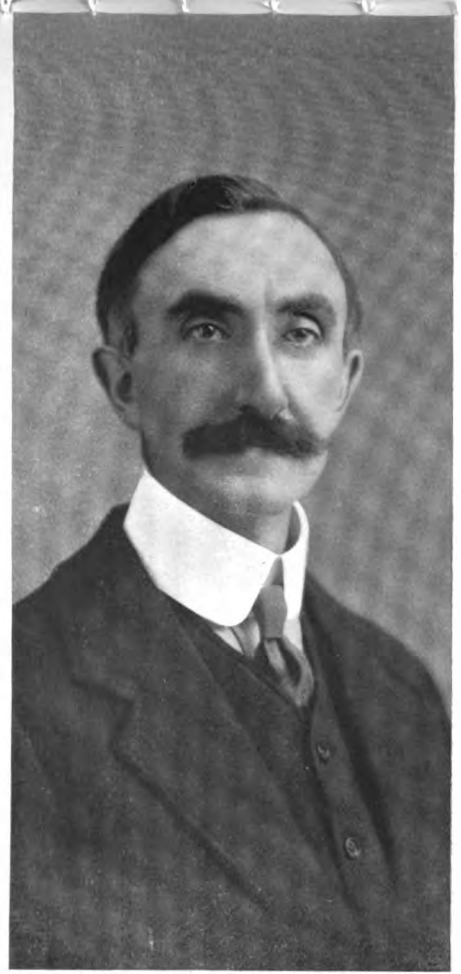
### MEDALS AWARD.

The following awards were made in respect of papers read before the Institution during the Session 1911–12.

*Senior Silver Medal.*—Mr. B. O. Anson for his paper entitled "Machine Switching."



Digitized by Google



WINNERS OF INSTITUTION MEDALS FOR SESSION 1911–12.

MR. R. NIMMO, SENIOR BRONZE MEDAL FOR PAPER ON "THE MANCHESTER FIRE ALARM SYSTEM."

MR. B. O. ANSON, SENIOR SILVER MEDAL FOR PAPER ON "MACHINE SWITCHING IN TELEPHONY."

MR. E. A. PINK, JUNIOR SILVER MEDAL FOR PAPER ON "PARALLEL DISTRIBUTION."



Digitized by Google

*Senior Bronze Medal.*—Mr. R. Nimmo for his paper entitled "The Manchester Fire Alarm System."

*Junior Silver Medal.*—Mr. E. A. Pink for his paper entitled "Parallel Distribution."

### Relay Clerks.

These officers, who were transferred to the Commercial Branch last year, have been re-transferred to the control of the Engineering Branch as Chief Inspectors or Senior Inspectors respectively. Those officers who were members of the Institution prior to the transfer may retain their membership, but new entrants will be admitted either as members or associates respectively.

### Reprint of Library Catalogue.

The Catalogue is now being reprinted in its present form, and it is hoped to supply all new members and associates with a copy before the end of the year.

The next meeting of the Council was fixed for November 18th, at Reading, when it was hoped an opportunity of meeting the members and associates of the South Midland Centre would be afforded.

## READING MEETING.

The November meeting of the Council was held at Reading on the 18th, when the following items of business were dealt with:

### Method of Appointing the Secretary of the Institution.

The proposal of the London Centre that the Secretary be appointed by the Council and not elected by the membership generally was further considered, and the Council were unanimous in deciding that the present practice of electing the secretary be adhered to.

### Financial Position of the Post Office Electrical Engineers' Journal.

The Sub-Committee appointed by the Council to inquire fully into the financial position of the Journal presented a comprehensive report, in which it was shown that as a business undertaking the Journal had been conducted in a thoroughly satisfactory manner.

The report was accepted and adopted unanimously.

### Reprint of Library Catalogue.

In view of the heavy expense involved in the reprint of the Catalogue, and the fact that all the members on the roll up to August last have been supplied with the last edition and all additions and amendments to date, it was decided to charge those members who required a copy of the new issue the sum of *6d.*

All new members and associates will be supplied with a copy of the Catalogue free as formerly.

### "President's Award Competition," 1913-14.

Mr. W. Slingo has kindly renewed his offer to present two prizes of three guineas each—one to the Clerical Staff and one to the Engineering—for the best essay on a clerical or engineering subject.

A circular has been issued to all members giving full details and the conditions of the competition. Notice of intention to compete must reach the Secretary before December 31st, 1913, and the essays must be delivered not later than February 28th, 1914.

### Membership.

The Secretary reported that during the current year 73 engineering, 13 clerical, 16 colonial and foreign members and 160 associates had been enrolled.



Digitized by Google

The South Midland, North Midland, South Lancashire and North-Western Centres were to be congratulated particularly on their accession of associates.

The Council had the pleasure of meeting the members and associates of the South Midland Centre, when an excellent paper on "Comparative Methods of Distribution" was read by Mr. B. J. Beasley. Mr. J. McL. Robb presided.

There was a large attendance, and the lively discussion which followed the lecture proved that all ranks of the staff took a great interest in the matter under review.

T. SMERDON (*Secretary*).

---

# LOCAL CENTRE NOTES.

## LONDON CENTRE.

THE first meeting of the Session took place on October 13th, when Mr. A. B. Eason read an interesting paper on "Power Plant and Telegraph Traffic for Pneumatic Tubes in Post Offices," in which he gave the results of his investigations into pneumatic tube working at various offices. Mr. H. R. Kempe had a very cordial reception upon rising to open the discussion.

Mr. Harvey Smith—one of our colleagues of the ex-N.T. Co.—occupied the attention of the second meeting on November 10th with a paper on "Telephone Engineering Economics, with Special Reference to Underground Plant."

Members will be interested to learn that Mr. Trotter, of the Board of Trade, has very kindly consented to read a paper before the Centre, and the Committee hope the arrangements will be so far advanced as to admit of a special meeting early in the New Year.

A party of members visited the Metropolitan Railways Power Station at Neasden on December 2nd, and met with a very courteous reception from the Company's staff.

By arrangement with the London Telephone Society the members of the Society may attend meetings of the Institution, and our members may attend meetings of the Society.

The Committee desire to congratulate Mr. B. O. Anson upon his success in obtaining the Institution's senior silver medal for his paper, "Machine Switching in Telephony," and Mr. E. A. Pink for the Council's award of the junior silver medal for his paper on "Parallel Distribution."

W. G. O.

## SOUTH-WESTERN CENTRE.

The first meeting of the current Session was held on November 3rd, when a paper on "Overhead Telegraph and Telephone Construction in France" was read by Mr. A. T. Kinsey, Assistant Superintending Engineer.

An interesting and instructive description was given of the differences in the methods of construction compared with British Post Office practice.

The paper was well illustrated by lantern views specially prepared, and by slides and drawings of telegraph construction in America, Denmark, Russia and Scandinavia, which had been loaned for this occasion.

Further meetings, details of which were not shown on the Display Card, have been arranged as follows:

1913.

December 8th.—"St. Just Wireless Station." Mr. C. G. Roach.

1914.

January 5th.—"Directive Wireless Telegraphy." Mr. F. Addey.

February 2nd.—"Local Underground Schemes." Mr. A. Rattue.

March 2nd.—"Early Experiments in Loading Cables." Mr. F. Tremain.

April 6th.—Short papers. To be arranged.



Digitized by Google

The meetings this Session are being held at the Merchant Venturers' Technical College, by kind permission of the Dean of the Engineering Faculty, Bristol University, and the opening meeting established a record for this Centre. The meetings of the Western Local Section of the Institution of Electrical Engineers are held in the same hall. On January 19th Mr. H. C. Gunton will lecture on "The Employment of Power in H.M. Post Office."

This Centre much regrets to have to record the death of Mr. N. S. Whittingham, which occurred on November 18th. Mr. Whittingham had been an active member of the Institution from its formation, and was the first Local Secretary of the North Wales Centre. In February, 1911, he contributed a paper on "Typical Wayleave Difficulties" before the South-Western Centre, and he served on the Local Committee for several years. He also took charge of the lantern arrangements on each occasion until the close of the 1912–13 Session.

## NORTH WALES CENTRE.

The opening meeting of the Session was held at the George Hotel, Shrewsbury, on Wednesday, October 29th, when Mr. Cave-Brown-Cave read a paper on "Ineffective Time." There were about sixty members and visitors present. Mr. T. Plummer, the Chairman, opened the proceedings with a few brief remarks, in which he welcomed the Inspectors who had recently been admitted to Associate Membership of the Institution. Mr. Cave's paper was very interesting and instructive, and a large number of members took part in the keen discussion which followed. Special credit is due to Mr. Cave for the very excellent diagrams prepared in connection with his paper.

The presence of the Engineer-in-Chief at the meeting, and also at the usual smoker which followed, was much appreciated.

## SOUTH LANCASHIRE CENTRE.

The following works are in progress in this district: Altrincham C.B. Exchange Extension, Heaton Moor Underground, Manchester–Stockport Underground, Manchester-Ashton Underground, Liverpool–Birmingham Underground, Manchester City Exchange Extension, and Stockport Automatic Exchange.

There has been a large increase in the membership of this Centre; the number of members and associates is now 105, which is considered very satisfactory.

So far three meetings have been held as follows: The first was held at Manchester on October 8th, at which the Chairman delivered his inaugural address and was followed by Mr. A. Magnall, who delivered a very interesting lantern lecture on the development of the telephone system of Constantinople.

The second meeting was held on November 3rd, when Mr. A. Ward read a paper on "Power Equipment."

The third meeting was held on November 12th, at Liverpool, the members and associates stationed at Manchester travelling to the famous port. At this meeting Mr. B. O. Anson delivered his lecture on "Machine Switching in Telephony"; the lecture was highly appreciated. This was a special meeting, and took the place of the meeting originally arranged for December 1st.

The average attendance at the three meetings was 79.

On November 3rd and 4th, the members and associates visited the Chloride Company's Accumulator Works at Clifton, Lancs., and on November 11th and 12th a visit was paid to the Automatic Telephone Company's Works at Edge Lane, Liverpool.

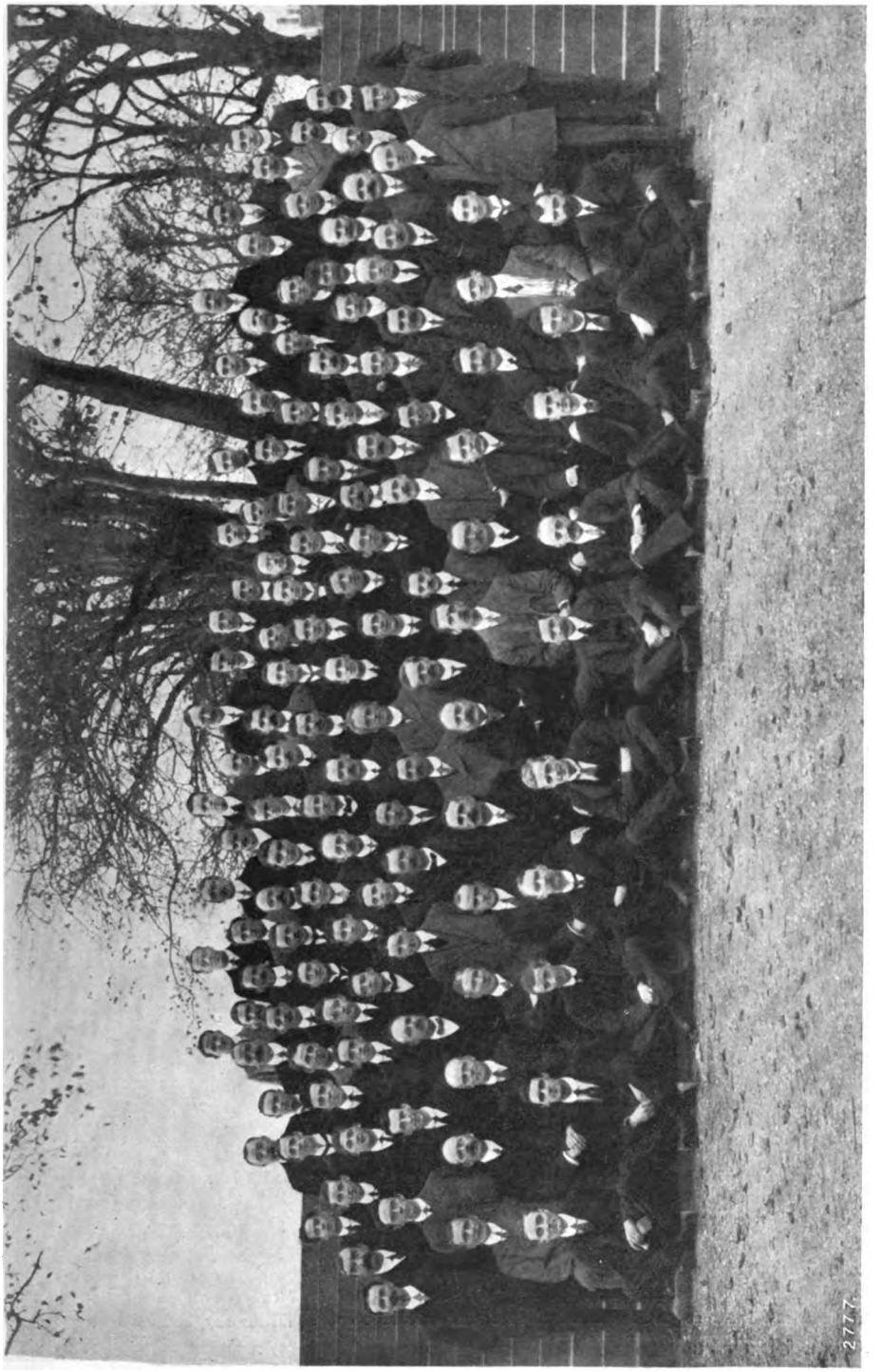
## NORTH-WESTERN CENTRE.

A meeting of the Centre was held in the Lecture Hall of the Preston Scientific Society on November 11th, 1913, when Mr. B. O. Anson, of the Engineer-in-Chief's Office, contributed a paper on "Automatic Telephony."

Mr. T. E. P. Stretche (Superintending Engineer) occupied the chair, and there was a record attendance.



Digitized by Google



THE NORTH-WESTERN DISTRICT HEADQUARTERS STAFF, PRESTON.
THE GROUP INCLUDES ALSO CERTAIN MEMBERS OF THE DISTRICT STAFF FROM THE SECTIONS.



Digitized by Google

The lecturer explained the mechanical and electrical details of the system, and built up a description on the basis that the function of the switches corresponds with the meanings of the digits forming the numbers. He showed how that, under the present conditions, subscribers' lines are often very long and lie idle for the greater part of the day, that is to say, the expensive copper circuits are probably not in use more than a total twenty minutes or half an hour daily. If automatic mechanism were introduced generally it would be possible to place apparatus much nearer to the subscribers' offices than is the case at present, and much more efficient use of the plant would follow.

The paper was profusely illustrated by means of an electric arc lantern, under the direction of Mr. H. B. Graham.

A most interesting feature of the proceedings was the demonstration of actual automatic apparatus, and those present made the most of the opportunities thus provided for becoming acquainted with the working details of the system.

A hearty vote of thanks were accorded to Mr. Anson for his excellent paper, and the numerous queries which had been raised were replied to *in extenso*.

A most successful smoking concert was held in the King's Hall of the Bull and Royal Hotel, Preston, on Monday, October 13th, 1913, when upwards of a hundred persons were present.

Mr. T. E. P. Stretche (Superintending Engineer) presided, and was supported by Messrs. Sullivan and Terras (Assistant Superintending Engineers).

Amongst the visitors were Mr. F. Oldfield (formerly Postmaster of Preston) and Mr. Haley (District Manager, P.O. Telephones, Preston). The whole of the sections of the District were also well represented.

A musical programme of exceptional merit was contributed by Messrs Barratt, Dransfield, Atkinson, Adams, Field, Knowling, Bland, Southgate, and Thompson, and Mr. Terras very kindly officiated in the capacity of accompanist. Encores were freely demanded and responded to, and the high artistic standard attained on previous occasions was fully maintained.

---

## NORTH-EASTERN CENTRE.

The first meeting of the Session was held at the Y.M.C.A., Leeds, on October 15th.

Mr. T. B. Johnson in opening the Session heartily welcomed the new members and associates, and expressed the wish that all members would consider that they are personally responsible for the success of the meetings. He laid stress upon the fact that the discussions following the reading of papers could only be of the greatest value to all present when expressions of opinion were freely forthcoming.

Mr. W. S. Tinsley read a paper on the "Transfer of Small Exchanges," and the discussion, which was opened by Mr. Tattersall, indicated that the Chairman's wishes were being met.

One of the pleasing features of the meeting was the free expression of opinion by our friends of the late National Telephone Company, and is a clear indication that now the Institution has been numerically strengthened not only by the entry of the late Company's staff but by the admission of associates, the meetings will be an even greater success than has been the case during previous sessions.

At the November meeting Mr. E. H. Farrand read a paper on "Short Cuts," which dealt with the present-day time-saving methods not only in the office, but on engineering works. The discussion which followed can readily be understood to have been very animated, as we all recognise that in the eyes of the commercial world we are looked upon as being clumsy in our methods. Had, however, any of the heads of the largest commercial concerns been at the meeting, they would have been convinced that at least the Post Office Engineering Department is fully alive to the requirements of the day, and that it was only the heavy burden entailed at this stage of the development of the telephone service that prevented its being, if not in advance of the outside commercial houses, at least well up to their standard.



Digitized by Google

## NORTH MIDLAND CENTRE.

The first meeting of the Session was held at the Welbeck Hotel, Nottingham, on November 3rd, when Mr. T. E. Matthews, of the Superintending Engineer's Office, gave a paper on "Estimate Procedure."

The proceedings were opened by an address from the Chairman, Mr. E. J. Eldridge, who reviewed the work of the previous session and gave a cordial welcome to the large number of associate members who attended for the first time. Mr. Matthews' paper proved to be highly interesting and instructive and was much appreciated. About eighty members attended the proceedings.

A "smoker" was subsequently held under the genial chairmanship of the Superintending Engineer, and a long and varied musical programme was rendered by members of the staff. Everyone acquitted himself well, and it would be invidious to attempt to apportion the merit for the evening's enjoyable entertainment.

## EASTERN CENTRE.

The first meeting of the Session was held at Cambridge on November 18th. The President, Mr. J. F. Lamb, in a short opening address expressed his gratification at the resumption of the meetings at this Centre with such an attractive item as "Wireless Transmitters and Receivers," by Mr. J. E. Taylor.

After the minutes of the last meeting had been read and confirmed, a vote of thanks to Mr. S. H. Deacon for his services as Honorary Secretary was proposed and carried unanimously. Mr. Lamb then called upon the lecturer, who dealt with his subject in a way which enabled a very great deal of ground to be covered in the short time available. Mr. Taylor said that he proposed to dwell rather on the physical side of the subject, as purely mathematical treatment without adequate physical conception of the various processes at work was apt to be unilluminative.

The theoretical principles of wireless communication, functions of essential parts of apparatus, principles of tuning and coupling, transfer of energy between coupled systems and Fourier principles were first briefly surveyed. Mr. Taylor then explained the characteristics of the various types of transmitters and receivers, their advantages and disabilities, factors affecting sensibility of receivers, etc.

Following on this was a very interesting reference to atmospheric electrical troubles, the paper concluding with some interesting remarks on "long-range" working. The discussion which followed, and which was taken part in by Messrs. J. C. Denton, J. F. Lamb, T. Lakey, E. T. Titterington, W. Scarr, and H. Wigg, showed that the paper had been followed with great interest.

At the close of the meeting the members were invited by Mr. Taylor to inspect an experimental apparatus with "tuned buzzer" and coherers; also many samples of receiver parts and materials—an appropriate conclusion to a most valuable and interesting lecture.

## IRELAND CENTRE.

Arrangements have been made for papers to be read during the Session on the following subjects:

"Some Points in Aërial Construction Work." Mr. F. W. Robinson.

"Straight Trunk Telephone Circuits on Telegraph Routes." Mr. J. McCandless.

"Work Returns." Mr. B. J. Maguire.

"Conveyors." Mr. J. Davidson.

"Conductors and Insulators." Mr. T. J. Monaghan.

"Acoustics." Mr. G. T. Fisher.

A visit will be made to Messrs. Harland and Wolff's ship-building works at Belfast early in February.



Digitized by Google

# THE POST OFFICE TELEPHONE AND TELEGRAPH SOCIETY OF LONDON.

## SESSION 1913-14.

SINCE the last Session the activities of the Telephone Society of London have been extended to include matters relating to telegraphs as well as telephones, and membership is now open to all members of the staff of the Post Office. The name of the Society has been amended as shown in the title of this article.

The first meeting of the newly organised institution of the Post Office was held in the lecture hall of the Institution of Electrical Engineers, Savoy Place, on October 27th last, under the presidency of Sir Alexander King, K.C.B., when the attendance was over 350.

In the absence of the Postmaster-General, who is President of the Society, the opening paper for this Session was delivered by the Chairman for the year, Mr. Alexander Moir, on "Some Features of the London Engineering District." After referring to some historical features of the Society, Mr. Moir dealt with the recent development of functional organisation in the London district, which has now to a large extent taken the place of territorial organisation, and he expressed himself as strongly in favour of the former. He also explained that the standard of efficiency in the London engineering district was measured by the number of faults, and described the method of showing the standard attained in each exchange district by means of curves and comparative schedules which are prepared periodically, and which engender friendly rivalry between the staffs of the different exchanges.

Mr. Moir was obviously in favour of the practice of treating supervision charges as a percentage on the fundamental costs of engineering works.

Mr. Moir dealt at some length on the great difficulties encountered during the last two years in the effort to bring into working harmony the telephone systems which had been built up separately by the Post Office and the National Telephone Company. He referred to the wholesale criss-crossing of subscribers' lines, and the difficulties of straightening out the system in such a way as to ensure that each subscriber was connected with his proper exchange by the shortest possible length of line. He detailed the steps which had been taken in reorganising and properly dovetailing the two staffs, and the strenuous efforts which are being made to secure greater efficiency.

He laid stress upon the need for maintaining a suitable balance between the supervising and working units. Insufficient supervision meant low efficiency and high labour costs, whereas excessive supervision led to waste, as high-grade officers were then employed upon work proper to a lower class.

Mr. Moir gave the following interesting account of the special arrangements for the training of workmen which have been made by co-operation between the London County Council, the Polytechnic Institutes and the Department. Under these arrangements the Post Office will pay the fees of the boy messengers and workmen in cases where they are successful in examinations or have made 80 per cent. of the necessary attendances. Theoretical teaching at the various institutions will be undertaken for the most part by the permanent and fully qualified staffs of the various institutes—a great advantage to the students; while the practical teaching will be in the hands of Post Office engineers and inspectors, who will for this purpose be specially employed by the educational authorities. Up-to-date types of telegraph and telephone apparatus will be lent by the Post Office for the purpose of illustrating the lectures. Over 1000 workmen and 54 boys have entered for the current Session, which is an increase upon last year's figures of nearly 100 per cent. The Regent Street Polytechnic and the Northampton Institutes have accepted 286 and 237 students respectively, and have both reached the limits of their accommodation. Well over 100 students have joined at Battersea and Tottenham, and large classes have been formed at the Borough, West Ham, Wimbledon and Chiswick Institutes. The launching of this scheme has involved a great deal of labour, which has been lightened by the hearty co-operation and help freely given by the officers of the County Council and the principals of the various institutes.



Digitized by Google

Not only in regard to technical education at evening classes, but in other ways, youths entering the service of the Engineering Department are helped to qualify as skilled workmen as early as possible. Separate courses of work covering a period of three or four years have been laid down for each of the distinctive types of duty carried out in the district, and as far as circumstances permit the boys follow the specified programmes. At the different headquarters of the workmen, facilities exist for testing young men in their practical knowledge of open-line construction and underground jointing and cabling, and specimens of the different types of outside plant are exhibited at these points for the instruction and guidance of the workmen. As regards internal equipment a central school has also been equipped with the different types of telephone apparatus, and instruction is given to "apparatus men" upon the practical difficulties that arise in connection with the tracing and removal of faults.

In dealing with the study of future development, Mr. Moir said that some interesting comparisons might be made between New York and London on the subject of telephone density. For instance, in New York, the number of telephones was evenly distributed over the city, and it was said to be possible to arrange for telephone development in large buildings where the principal financial houses are situated on an average basis of 4 or 5 telephones per 1000 square feet of floor space. In London, on the other hand, the variation in density was great, necessitating special studies which had been extended to some 3000 buildings. Warnford Court and Shorters Court in the corresponding district of London were quoted as cases where the number of telephones per thousand square feet of floor space reached 12 and 53 respectively. The following figures show the present and anticipated figures in London according to the latest development study, viz.

| | Lines. | Stations. |
|---|---|---|
| 1913 | 130,000 | 222,000 |
| 1921 | 267,000 | 432,000 |
| 1928 | 414,000 | 680,000 |

In the very congested portions of London, Mr. Moir pointed out, the exchanges are of the largest practicable size, namely, sufficient to accommodate 10,000 subscribers' lines, and in two cases it has been found economical to have two 10,000-line exchanges in one building. Since the whole undertaking came into the hands of the Post Office seven new exchanges have been opened and two others are nearing completion, providing additional capacity for 62,000 lines, and by December 31st next the exchange capacity in London will be 194,000 lines – an increase for the two-year period of 31 per cent. Exchanges of the maximum size are also to be provided near the Charterhouse and the Tower, and proposals for others are well advanced.

Mr. Moir concluded his paper by exhibiting a slide showing the front elevation of the proposed new central building for the London Engineering Staff, who are at present scattered over the district, and said that they, like the Israelites of old, were longingly looking forward to the promised land.

The other speakers were Mr. Horne, Mr. Preston, Mr. Newlands, Mr. Dalzell, and Mr. Berlyn.

On November 24th, Mr. John Newlands, C.I.E., the Controller of the Central Telegraph Office, read an interesting address on "The Telegraph Service: Methods and Results."

Mr. Newlands commenced his paper by giving an historical survey of the telegraph service from its birth in Germany in 1833 to its prime of life at the present day. He traced its growth in the British Islands during the reign of the telegraph companies (1838–1870), when the methods of working were diverse, the system incomplete and the tariff prohibitive, during the early days under Post Office control (1870–1885), when the tariff was one shilling for twenty words, during the stress of the times immediately following the introduction of the sixpenny telegram in 1885, that concession so immortalised by 'Punch' in his cartoon entitled "Bang went saxpence," down to the last two decades when the competition of the telephone service for the short distance traffic led to a restriction of the sphere of the telegraph service.

Mr. Newlands then compared the results obtained from the different types of telegraph instruments; and, after dealing with their respective idiosyncrasies, he expressed a decided preference for the "Baudot" type, which he justified by the following reasons, viz.:



Digitized by Google

It produces a clear printed slip at both ends, and no perforation is necessary beforehand. The received message is reproduced at the distant end in ordinary type instead of in Morse character, and the slip can be torn off and pasted on telegraph delivery forms while the transmission is proceeding. It can be worked duplex, as double Baudot, as triple, quadruple, or sextuple, and when thus elaborated, six, eight or twelve men can send or receive simultaneously on the same single wire or underground loop. The percentage of words in transmission involving "RQs" or corrections is small, and the mode of working admits of such corrections being made instantly. The risk of losing messages is infinitesimal. The manipulation can be learned more readily and efficiency obtained more quickly than with any other type of telegraph. The number of messages per operator is more constant and the average higher. In support of his views as regards a higher average of working, Mr. Newlands gave the following analysis, viz.:

*Comparative Operating Costs at the C.T.O. of Various Systems of Telegraphy—One Week's Traffic.*

| System. | Circuits. | No. of lines worked. | Traffic. | Operator hours. | Average per operator hour. |
|---|---|---|---|---|---|
| Baudot . . . | TS.–Birmingham | 1 | 15,040 | 347·5 | 43 |
| Wheatstone with Creed | TS.–Edinburgh | 4 | 15,860 | 450 | 35 |
| Hughes . . | TS.–Glasgow<br>TS.–Manchester<br>TS.–Liverpool | 3 | 13,364 | 389·3 | 34 |
| Morse Provincial Offices | TS.–Leeds<br>TS.–Bradford<br>TS.–Sheffield | 3 | 5,911 | 191·5 | 31 |
| Morse Metropolitan Offices | TS.–Boro' High Street<br>TS.–S.W. District<br>TS.–Aldgate | 3 | 4,455 | 147 | 30 |
| Wheatstone without Creed | TS.–Bristol<br>TS.–Grimsby<br>TS.–Southampton<br>TS.–Dublin<br>TS.–Newcastle<br>TS.–Plymouth<br>TS.–Aberdeen | 16 | 67,208 | 2560 | 26 |

*One Week's Traffic: Best Single Results for each System.*

| System. | Circuit. | No. of lines worked. | Traffic. | Operator hours. | Average per operator hour. |
|---|---|---|---|---|---|
| Baudot . . | TS.–Birmingham | 1 | 15,040 | ·347·5 | 43 |
| Hughes . . | TS.–Glasgow | 1 | 4,484 | 125·3 | 36 |
| Wheatstone with Creed | TS.–Edinburgh | 4 | 15,860 | 450 | 35 |
| Morse Provincial Office | TS.–Leeds | 1 | 2,064 | 63·75 | 32 |
| Morse Metropolitan Office | TS.–Boro' High Street | 1 | 1,421 | 44· | 32 |
| Wheatstone without Creed | TS.–Bristol | 2 | 13,231 | 476·75 | 28 |



Digitized by Google

*Summary of Six Days' Wheatstone Working (Variable Periods).*

| Circuits. | No. of wires used. | Traffic. | Hours. | Average rate. | Percentage of delay. | |
|---|---|---|---|---|---|---|
| | | | | | Twenty minutes. | Over twenty minutes. |
| TS.-DN. | 2 | 8,952 | 398 | 22·5 | 48·8 | 51·2 |
| TS.-AB. | 2 | 4,921 | 210 | 23·4 | 48·0 | 52·0 |
| TS.-PY. | 2 | 4,134 | 164 | 25·1 | 69·7 | 30·3 |
| TS.-NT. | 3 | 14,308 | 564 | 25·4 | 74·3 | 25·7 |
| TS.-SO. | 3 | 12,673 | 474 | 26·8 | 74·3 | 25·7 |
| TS.-GY. | 2 | 8,989 | 333 | 27·0 | 68·8 | 31·2 |
| TS.-BS. | 2 | 13,231 | 477 | 27·7 | 65·5 | 34·5 |
| | | 67,208 Average | for above | 25·6 | | |
| TS.-EH. | 4 | 15,860 | 450 | *35·2 | 43·3 | 56·7 |

* Higher average due to Creed Printers.

*Compare with Traffic, etc., on One Baudot Circuit.*

| | | | | | | |
|---|---|---|---|---|---|---|
| TS.-BM. | 1 | 15,040 | 347 | 43 | 90 Average re-Tablet Ch in 1913. | 10 sults of 10 eck Returns |

*Comparison of Results, showing Output obtained.*

| Apparatus. | Circuit. | No. of wires. | No. of days. | Total traffic. | Average per operator hour. | Highest hour. |
|---|---|---|---|---|---|---|
| Duplex . . . . | TS.-BR. | 2 | (4 hrs.) | 447 | 56 | — |
| Quadruplex . . . | TS.-DN. | 1 | 12 | 12,728 | 34·5 | 205 |
| ,, . . . . | TS.-BR. | 2 | 4 | 10,347 | 37·7 | 360 |
| Hughes . . . . | TS.-GW. | 1 | 3 | 3349 | 44 | 144 |
| Wheatstone (with Creed) . | TS.-EH. | 3 | 1 | 3848 | 36·3 | 646 |
| Wheatstone . . . | TS.-NT. | 3 | 6 | 14,308 | 25 | 550 |
| Murray Auto. . . . | TS.-LS. | 1 | 1 | 1555 | 32·4 | 270 |
| ,, Mult. . . . | TS.-MR. | 1 | 1 | 1637 | 40·9 | 231 |
| Baudot . . . . | TS.-BM. | 1 | 1 | 5130 | 46 | 608 |
| ,, . . . . | ,, | 1 | 6 | 24,025 | | |

In dealing with punching apparatus, Mr. Newlands stated that experience in the Central Telegraph Office showed that the best results were obtained by the Gell perforator, and that the average rate of perforating during six days on eight representative circuits was 53·3, 34·8, 37·4 messages per hour for Gell perforators, Kotyra "tappers," and hand punching apparatus respectively.

The practice of typewriting messages received by sounder apparatus or by Morse printers of the various kinds is on the increase, and Mr. Newlands urges the need for a quieter, simpler and cheaper typewriter. He considered that a typewriter with four rows of ten keys each, one with figures from 1 to 0, and the remainder with capital letters of plain character and certain of the more usual symbols as secondary characters, would best meet the need provided the typewriting was clearly visible to the operator. In this connection he pointed out the advantages which would accrue from a standardisation of the keyboards of typewriters and perforators in use in the Central Telegraph Office having regard to the fact that rotation between ordinary operating and manipulation of perforators or typewriters is necessary in the interests of the staff themselves.



Digitized by Google

Mr. Newlands is in favour of the system of "urgent telegrams" which is so popular (if practical compulsion may be regarded as productive of popularity) on the continent; but on this point no doubt opinions are divided. Such a system would necessarily lead to delay in dealing with the non-urgent traffic; and the standard which Mr. Newlands and his colleagues have set for the ordinary telegraph service in this country is already as high as that of the "urgent telegram" in other countries.

Mr. Newlands laid great stress on the fact that there was no attempt at what is colloquially termed "speeding up." He pointed out that in 1893, the responsible telegraph officers—all of whom had been telegraphists who had risen from the ranks—were generally agreed that 30 telegrams an hour was fair, 35–40 was good and 50–60 indicated pressure. Since that date the rate of working at the Central Telegraph Office has been decreased by the introduction of the intercommunication switch, the telewriter and the phonograms and the acceleration of the news services; and has been increased by the adoption of mechanical inventions—such as the Baudot, Murray, Creed and Gell—which have not only revolutionised modern telegraphy, but have also relieved the staff of much key working with its attendant physical fatigues. Yet the actual returns furnished to the Secretary during the last ten years show that the average number of messages per operator varies from twenty to twenty-three per hour. This average figure in Mr. Newlands' opinion conceals much excellent individual work because it is an "average" covering a twelve-hour day from 8 a.m. to 8 p.m.; but he, not unnaturally, considers that there is a wide margin between such average and anything of the nature of over-pressure.

Mr. Newlands made several other suggestions, some of which perhaps are counsels of perfection which in this imperfect world it may be difficult to realise, such as: The use throughout the service of a code of abbreviations habitually used by press correspondents; the compulsory inclusion of an indicator word in every registered telegraphic address in London; the use of typewriters by the public for writing out telegrams; the reduction in length of service instructions and the discontinuance of needless service telegrams; and the revision of the arrangements for transmitting figures. In addition, he advocated strongly the institution in the Telegraph Service of such periodical conferences between the chief executive officers as those which have proved so useful and generally advantageous in the Telephone Service.

The other speakers were Mr. V. M. Dunford, Mr. W. H. P. Smith, Mr. G. Jessup, Mr. W. Noble, Mr. J. J. Tyrrell, Mr. J. Bailey and Mr. Gell. Over 500 members and visitors were present.

On December 15th, Mr. P. W. H. Maycock, of the London Telephone Service, gave an address on Telephone Traffic Statistics. Mr. Maycock, who has studied the question of traffic statistics for several years both as exchange manager and as an expert attached to the traffic staff of the Controller's Office, considered that traffic statistics must be applied in such a way as to form criteria of the efficiency of the service under the following headings, viz.:

(1) The point of view of the subscriber.
(2) The efficiency of the operators.
(3) The efficiency of the subscriber.
(4) The arrangements for estimating and dealing promptly with traffic pressure.

The results of the statistics he thought should invariably be expressed in the form of curves. The curves which Mr. Maycock presented to the audience no doubt convinced them on this point if in this year of grace such conviction is not already an established fact. I sometimes myself wonder whether some of the fondness of statisticians for curves is not due to the unfortunate label which has been attached to "statistics" and their progenitors. Certainly a curve does look simple and trustworthy.

In dealing with complaints from the point of view of the subscriber Mr. Maycock gave reasons for his view that the relation of the number of complaints to the total amount of the traffic was the true index of the service as it presents itself to the subscriber, and not the relationship of the number of complaints to the number of lines or some other factor. In view of the doctrine of the measured rate that the Post Office is selling telephone service and not telephones, there is much to be said from this point of view.



Digitized by Google

Under Mr. Maycock's scheme written complaints only were to be considered in the standard "complaint" curve, owing mainly to the impossibility of getting a uniform standard of differentiation as between "complaints" and "inquiries." He suggested, however, the desirability of a supplemental curve giving "complaints" and "inquiries" together in relation to traffic, justification for the combination being found in the fact that "complaints" and "inquiries" alike arise from service difficulties. Of the suggested "complaint" curve the basis chosen was "complaints per thousand originated calls." Mr. Maycock also gave reasons for the view that any study from the traffic point of view of the number of faults reported in a given time to the Engineering Department should also be on a traffic basis; and he considered that a curve—to be plotted daily—showing the reported faults per thousand originated calls is a necessary adjunct to the "complaint" curve and a useful complement to the fault statistics outlined by Mr. Moir in his paper at the beginning of the Session.

In respect of the efficiency of the operator, Mr. Maycock dealt with the matter from the two points of view of (*a*) speed of operating and (*b*) accuracy of operating. He obtained much of his information from the observation tables, and proceeded to project various curves showing speed of answering calls, percentage of calls answered within standard of four seconds, speed of answering "flash" signals and speed of connection As regards the accuracy of operating, he required curves representing the percentage of completed calls, percentage of operating irregularities, the percentage of calls in which no operating irregularities occur, *i.e.* calls handled correctly from start to finish, and accuracy of registration. Cogent reasons were given why efforts to obtain in individual cases a speed of answer higher than the standard rate should not be encouraged.

Mr. Maycock pointed out that the "efficiency of the subscriber" was an all-important part of an efficient telephone service, and he expressed the view that the education in matters telephonic of the subscriber was imperative. He acknowledged that at first sight accepted statistics seem to show that, as measured by operating irregularities, the telephonist in London is worse than the subscriber; but he pointed out that the same standard of severity is not applied to operators and subscribers alike, and that if the same measure be employed the subscribers' faults are twice as numerous as those of the telephonists. He gave the following figures in justification of his statements, viz.:

| | Nominally. | Actually. |
|---|---|---|
| Relative percentage of irregularities of operator and subscriber | 30·1 : 11·3 | 63·6 : 30·1 |

As evidence of the need for the systematic education of the subscriber, the following statistics were given, viz.:

| | Percentage of total calls. |
|---|---|
| Subscriber passes number incorrectly | 14·9 |
| ,, speaks indistinctly | 6 |
| ,, asks for wrong number | 1·29 |
| Called subscriber fails to announce his identity promptly | 8·46 |
| Subscriber fails to clear or delays clearing | 5·86 |
| ,, fails to give number promptly | 3·81 |
| ,, leaves telephone and caller becomes impatient | 2·51 |
| ,, calls Exchange unnecessarily | 2·23 |
| ,, fails to answer interrogation "Have they answered?" | 1·59 |
| ,, called does not wait for conversation | 1·22 |

Perhaps some of the audience recognised the faults to which they were most prone. Mr. Maycock urged that in the criticism of service an equal standard should be applied to telephonists and subscribers, and that the curve of subscribers' irregularities should be based on such data: that such a curve should be kept in each exchange and used with a series of instructional leaflets.

On traffic pressure, Mr. Maycock considered that quarterly and monthly peg counts were inadequate, and that daily peg counts by aid of position meters should invariably be taken, the readings being taken at half-hourly intervals between 9 a.m. and 12 noon. These statistics would also show the relative "loads" at the operating positions, and



Digitized by Google

should be used with predetermined maximum and minimum limits for equalising the loads of the operating positions.

With regard to traffic pressure, Mr. Maycock submitted evidence that, for the purpose of indicating the true requirements of the busy hour, daily busy hour records must be taken if the Post Office standard of service is to be maintained. The inadequacy of quarterly and even monthly peg counts for the purpose of supervision of the busy hour load of the exchange was demonstrated, and the systematic plotting of curves showing the daily busy hour load of the exchange and the loads of individual operators in relation to minimum and maximum load limits was advocated. The necessity for close supervision of junction traffic pressure was pointed out, evidence being given of marked fluctuation in the main factors determining junction requirements—factors frequently regarded as constant. Suggestions were made as to frequency of junction records and the graphic analysis of the results.

In conclusion Mr. Maycock reviewed the general case for systematic statistical records at Exchanges, urging the necessity of preparing for the possibility of decentralisation by laying down a standard system which would, in the ordinary course of its use, familiarise all Exchange controlling officers with some of the main principles of scientific traffic control.

## CHESS CLUB.

THE Engineering Department Chess Club opened its tenth season on October 7th, 1913, and with Arbitration proceedings, which last season deprived the Club of many of its players, now happily a thing of the past, a more successful season is anticipated.

The Club is again competing in the First Divison of the Civil Service and Municipal Chess League, and at the date of writing these notes, losses have to be recorded in respect of matches with Somerset House and the L.C.C., while a draw was effected with the War Office.

The Club Championship and Tournament have attracted numerous entrants, and as the "cup-tie" system has been adopted keen contests are resulting.

## RETIREMENTS IN 1913.

### MR. J. W. GROVES.

Mr. J. W. Groves retired from the position of Superintending Engineer on May 31st under the age limit, after having completed forty-five years' service.

Mr. Groves entered the service of the United Kingdom Telegraph Company at Bristol in 1863. A year later he was transferred to Leeds, at which office he was stationed, when his Company's circuit, and those of the Electric and International and the British and Irish Magnetic Companies were concentrated at the Post Office. In 1870 Mr. Groves was transferred to Newcastle, where he had experience of submarine cable working, and became acquainted with Mr. Oliver Heaviside, the famous mathematician and electrician, and Mr. J. W. Swan, the inventor of the carbon process of obtaining permanent photographic prints and of the incandescent electric lamp. After a stay of eight years on Tyneside Mr. Groves was promoted to the position of repeater clerk at Haverfordwest. While at Haverfordwest he received the thanks of the Engineer-in-Chief for



Digitized by Google

designing a short-circuit detecter, and also for a non-polarised relay to be used in place of the electro-magnetic switch.

In 1885 Mr. Groves was selected for the position of Inspector at Cambridge. On the occasion of the illness and death of the late Duke of Clarence he was in charge of the engineering arrangements, and, with Mr. T. Mason of the Special Staff, was quartered in the Bachelors' Cottage.

MR. J. W. GROVES.

In the "old days" Mr. Groves's section extended from a point south of Harlow to the mouth of the Wash, a distance of over 100 miles.

After passing through the grades of 2nd Class and 1st Class Engineer and Assistant Superintending Engineer Mr. Groves was promoted to the position of 1st Class Staff Engineer. During three years on the Headquarters Staff Mr. Groves inspected and reported upon practically every trunk telephone exchange in the country. During the same period he was responsible for the application of the



Digitized by Google

Unit Cost System. The establishment of lineman's loads also came under his review. Mr. Groves was subsequently promoted to be Superintending Engineer of the North-Western District, since rearranged so as to include Liverpool, and now known as the South Lancashire District.

Mr. Groves took great personal interest in the local branch of the I.P.O.E.E., and under his chairmanship the programmes were satisfactorily filled during successive sessions.

On his retirement the good wishes of a number of his personal friends in the Engineering Department were expressed in tangible form by the presentation of several pieces of silver plate suitably engraved.

MR. T. JENKYNS.

By the unavoidable flight of time, which brought on the age-limit, Mr. T. Jenkyns, Assistant Superintending Engineer in the South Wales District, recently retired from the activities and anxieties of official life. After a service of forty-three years it is felt Mr. Jenkyns fully deserved the leisure which he has earned by the conscientious and careful carrying out of the duties of the various positions he has filled. His genial and generous nature made him an officer greatly liked and looked up to by his fellows. It is impossible to imagine a case in which he could or would do harm or hurt to anyone, and, as was said at a farewell gathering years ago in regard to a colleague of Mr. Jenkyns, so it can be truthfully reiterated in respect of the latter, "He never saw nothing he didn't ought to." The best—the humane—side was always seen, and men of all ranks honour his name, and reflect that his attitude was ever considerate, and at the same time candid. It was always a matter of measuring, remembering and estimating circumstances, and rarely would there be a repetition of the offence. A great heart and a sympathetic spirit characterised all his dealings with men. Yet he ever held with



Digitized by Google

dignity and satisfaction to his superiors his official position. All were sorry when they knew he must take off the official armour. He passed through years of strenuous toil and incessant grinding. When the Department started "competition" in telephone matters in the South Wales District Mr. Jenkyns was at Newport (Mon.), and in that area he had his hands full, and more than full. There are those left who remember those days of stress and strain, and are only too glad to know that the end of the days of great pressure has come to him. Mr. Jenkyns goes out of harness not to be forgotten, but to be in frequent recollection. His old colleagues express a sincere hope and wish that his freedom from official cares will enable him to enjoy many years of quiet and rest. He will not, it is thought, be idle altogether, for probably he will now have time to play bowls occasionally and opportunity to read more of those standard works with which he has for many years stored his mind and enlarged his vision of men and affairs. C. J. Y.

## MR. J. J. HARDIE.

Mr. Hardie commenced his established career as a telegraphist in Aberdeen, although he had acquired the rudiments of the art at Lerwick, in the Shetlands, where his uncle, Mr. Stout, performed the dual duties of postmaster and engineer—an unique combination which ceased on the death of Mr. Stout, some fifteen years ago.

He was appointed a junior clerk at Glasgow in 1897, and in 1899 he entered the technical side proper as a sub-engineer in the same district, being located in the Superintending Engineer's office. During that period he acted as relief engineer and subsequently performed the duties now proper to the post of estimates engineer for the district. Passing the departmental examination for second-class engineer in 1903 he was appointed to the Engineer-in-Chief's office, and for seven years he was engaged in the Designs Section. During that period he was largely concerned with the installation and standardisation of secondary cell equipments for telegraph offices, was responsible for the provision of apparatus supplies and the execution of special requisitions, and was of considerable service in the preparation of the rate-book and the codification of stock nomenclature.

Mr. Hardie was promoted to the rank of First-class Engineer in 1910 and in the following year he was made an Executive Engineer. For about a year he was in charge of the Central Metropolitan East Section, but his wide knowledge of telegraphs led to his transference to the C.T.O. Section. He was nominated for examination as Assistant Staff-Engineer, but unfortunately he was unable to attend the examination owing to a serious illness. He resumed duty at the C.T.O. after six months' absence, but at the end of a



Digitized by Google

similar period he was again compelled to rest and in September last he was placed on the retired list.

A typical Shetlander, one half Scot, one half Norseman, Mr. Hardie possesses within a frame that has never been robust an indomitable dogged perseverance and a very acute intellect which is ever seeking fresh problems to solve, and which many times has carried him beyond his physical safety limit.

He is by nature rather reserved and he never sought the limelight, but to his credit stands a vast amount of sound, solid work, conscientiously carried out with a single eye to the interests of the Department and to the honour of the profession.

His many friends will be pleased to hear that he is now convalescent, and that there are prospects of his being able to enter into active life again. "J. J." was never content to watch others doing the work, except perhaps at Stamford Bridge.

### Mr. Nelson Bathurst.

Mr. Nelson Bathurst was one of the few remaining members of the old Metropolitan Engineering staff.

Mr. Bathurst commenced his career in the service at Redhill, Surrey, in the memorable year of the Telegraph Transfer, 1870. He was later transferred to the Central Telegraph Office, and in 1880 he was appointed a clerk to the Metropolitan District under Mr. Eaton, who was then Superintending Engineer, with Mr. T. H. Hill as his assistant. At that period the total clerical force of the Metropolitan District was eight! The engineers being Messrs. Fleetwood, Banker, Hook, Trott, Porter and Houston. Of the engineers none remain in the Service, and only two of the clerks, Messrs. E. J. Wood and W. Heath.

Mr. Bathurst has been absent from duty, owing to ill-health, for about a year, but his many friends will be glad to know that he has recently recovered his normal condition, and he will be followed into retirement with the good wishes of all for a long and happy enjoyment of his well-earned pension.

---

## REFERENCES TO CURRENT TECHNICAL LITERATURE.

'Telephony' (U.S.A.), September 6th, p. 23 *et seq.*—"Tale of the Telegraph and Trials of the Telephone Re-told." G. W. Foster.

——— September 13th, p. 31.—*Ibid.*

'Elec. World' (U.S.A.), September 6th, p. 477 *et seq.*—"Data Concerning Incandescent-Lamp Reflectors." Stickney and Powell.

'Engineering Mag.' (U.S.A.), September, 1913, p. 793.—"Motor Trucks in Engineering Work." R. W. Hutchinson, jun.

——— September, 1913, p. 822.—"Air Compressors and Compressed-Air Machinery." Prof. R. L. Streeter. The first of a series of six articles.



Digitized by Google

'Engineering Mag.' (U.S.A.), September, 1913, p. 843.—"Power Applications of Diesel Engines in Industrial Plants." C. Van Langendonck.

'Elec. World' (U.S.A.), September 20th, p. 586.—"Graphic Solution for Illumination Problems." N. S. Dickinson.

'Telephony' (U.S.A.), September 20th, p. 26.—"Prevention of Electrolytic Corrosion of Lead Cable." B. C. Groh.

'Cassier's Eng. Monthly,' October, 1913, p. 215.—"The Gas Turbine." L. Venton-Duclaux.

——— October, 1913, p. 229.—"Modern Developments in Fire Preventive Design and Construction." H. G. Holt.

——— October, 1913, p. 259.—"The First Diesel Locomotive." P. R. Allen.

——— October, 1913, p. 265.—"The Hours of Labour Problem." T. Good.

'Telephony' (U.S.A.), September 27th, p. 33.—"Telephone Stations of the World at the Beginning of 1912." W. H. Gunston.

'Electrician,' October 10th, p. 14.—"Sine-wave Transmission in the Submarine Telegraph Cable." H. W. Malcolm, D.Sc.

'Scientific American Supplement,' October 11th, p. 232.—"Accident Prevention." Jas. B. Douglas.

'Engineer,' November 21st, 1913.—"Boiler and Economiser Efficiency and Design, III."

'Engineering Mag.,' November, 1913.—"Handling Mail-Bags at a Rapid Rate."

## LIBRARY NOTES.

THE following surplus copies are to be disposed of to members of the Institution. The books are in good condition. Offers for same should be forwarded to The Librarian, Room 50A, G.P.O. West, E.C.

'Electric Wave Telegraphy,' 1906 edition. J. A. Fleming.
'Wireless Telegraphy,' 1907 edition. J. E. Murray.
'Handbook of Telephony,' 1906 edition. J. Poole.
'Telephony,' 1905 edition. K. B. Miller.
'Internal Wiring of Buildings,' 1903 edition. H. M. Leafe.
'Applied Mechanics,' 1904 edition. A. Jamieson.
'Wireless Telegraphy,' 1904 edition. C. H. Sewell.
'C.G.S. Units,' 1902 edition. J. D. Everett.

## Mr. A. E. McCLOSKEY.

Mr. A. E. McCloskey, who returned from India in March, where he had been on loan to the Bombay, Baroda, and Central India Railway for a period of three years, has been appointed Engineer-in-Chief, Postal Telegraphs, Ceylon, and sailed for Colombo on November 8th. His duties will be comprehensive, as they include not only the installation and maintenance of the telegraph and telephone systems on the island, but also the maintenance of the Colombo wireless station and the railway signalling arrangements over the entire service.

His experience in India will stand him in good stead in connection with the last-mentioned portion of his duties. It is understood he was in sole charge of the electrical portion of the railway company's equipment during the journey of the Royal party from Bombay to Delhi to hold the Durbar, and for his services in that connection he



Digitized by Google

was awarded a handsome bonus and the thanks of the railway authorities. Before leaving for England he was presented by the staff with a magnificent embossed silver salver and an illuminated address contained in a silver casket supported on crossed rifles.

While in India Mr. McCloskey underwent a severe attack of enteric fever, which incapacitated him for several months. We hope the seasoning he received during his first trip "east of Suez" will enable him to keep clear of all similar troubles, and thus secure to the Colony the uninterrupted services of an excellent engineer, capable and prompt in emergencies, with a wide and varied experience, and withal of an unfailing humour which rises superior to every adversity.

## STAFF CHANGES.

### POST OFFICE ENGINEERING DEPARTMENT.

PROMOTIONS.

| Name. | From. | To. | Date. |
|---|---|---|---|
| Chapman, A. E. | Exec. Engr. S. Western Dist. | Asst. Supt. Engr. S. Western Dist. | 17 : 11 : 13 |
| Barber, J. W. | Exec. Engr. N. Eastern Dist. | Asst. Supt. Engr. S. Lancs. Dist. | 22 : 10 : 13 |
| Terras, J. S. | Exec. Engr. N. Wales Dist. | Asst. Supt. Engr. N. Western Dist. | 1 : 7 : 13 |
| Gilbert, A. B. | Exec. Engr. Scotland W. Dist. | Asst. Supt. Engr. Scot. E. Dist. | 7 : 11 : 13 |
| Wolstenholme, C. S. | Exec. Engr. S. Lancs. Dist. | Asst. Supt. Engr. N. Eastern Dist. | 13 : 11 : 13 |
| Baldwin, F. G. C. | Exec. Engr. London Dist. | Asst. Supt. Engr. Northern Dist. | 1 : 12 : 13 |
| Cardrey, A. G. | Asst. Engr. London Dist. | Exec. Engr. | — |
| Wells, R. A. | Asst. Engr. E. in C.O. | ,, | — |
| Bramwell, J. T. | Asst. Engr. Northern Dist. | Exec. Engr. S. Lancs. Dist. | 17 : 11 : 13 |
| Cameron, J. | Asst. Engr. Scotland W. Dist. | Exec. Engr. | — |
| Jenkins, I. H. | Asst. Engr. E. in C.O. | ,, | — |
| Thompson, H. S. | Asst. Engr. E. in C.O. | ,, | — |
| Francis, E. S. | Traffic Supt. Liverpool | ,, | — |
| Newton, E. W. | Asst. Engr. S. Eastern Dist. | ,, | — |
| Shea, J. | Asst. Engr. S. Lancs. Dist. | Exec. Engr. S. Lancs. Dist. | 6 : 11 : 13 |
| Ryall, J. B. | Asst. Engr. London Dist. | Exec. Engr. | — |
| Gardner, A. W. | Engr. 2nd Cl. Eastern Dist. | Asst. Engr. | To be fixed later. |
| Fewtrell, J. W. | Engr. 2nd Cl. E. n C.O. | ,, | ,, |
| Golding, W. | Engr. 2nd Cl. S. Wales Dist. | ,, | ,, |



Digitized by Google

PROMOTIONS—*continued.*

| Name. | From. | To. | Date. |
|---|---|---|---|
| Everatt, W. C. | Engr. 2nd Cl. N. Eastern Dist. | Asst. Engr. | To be fixed later. |
| Dawson, A. E. | Engr. 2nd Cl. Ireland Dist. | ,, | ,, |
| Waters, E. W. | Engr. 2nd Cl. London Dist. | ,, | ,, |
| Bell, R. W. S. | Chief Inspector N.W. Dist. | Asst. Engr. S. Lancs. Dist. | 24 : 11 : 13 |
| Ritter, E. S. | Junr. Engr. E. in C.O. | | 17 : 5 : 13 |
| Werren, H. T. | Do. | | 17 : 5 : 13 |
| Hill, H. | 3rd Cl. Clerk E. Dist. | | 4 : 5 : 13 |
| Hinton, N. P. | | | 4 : 4 : 13 |
| Hanna, W. | | | 10 : 4 : 13 |
| Ellson, F. A. | | Asst. Engr. on probation | 14 : 4 : 13 |
| Grieveson, A. F. | | | 14 : 4 : 13 |
| Hannaford, F. S. | | | 14 : 4 : 13 |
| Morgan, J. | | | 14 : 4 : 13 |
| Innes, J. | | | 15 : 4 : 13 |
| Gill, A. J. | | | 21 : 4 : 13 |
| Boryer, W. F. | | | 1 : 5 : 13 |
| Stone, A. E. | | | 1 : 5 : 13 |
| Morris, A. | | | 7 : 7 : 13 |
| Harris, W. T. | 3rd Cl. Clerk Lond. Dist. | 2nd Cl. Clerk Lond. Dist. | 24 : 11 : 13 |
| Cole, G. G. | Do. | Do. | 24 : 11 : 13 |
| Gell, E. R. | ,, | ,, | 24 : 11 : 13 |

TRANSFERS.

| Name. | Rank. | Transferred from | To | Date. |
|---|---|---|---|---|
| Barber, J. W. | Exec. Engr. | N. E. | S. L. | 12 : 9 : 13 |
| Nimmo, R. | ,, | N. W. | S. W. | 12 : 11 : 13 |
| Blight, W. O. | Asst. Engr. | London. | E. in C.O. | 16 : 7 : 13 |
| Murphy, F. | ,, | ,, | ,, | 1 : 10 : 13 |
| Gadsby, G. J. | ,, | ,, | ,, | 2 : 11 : 13 |
| Warren, A. | 3rd Cl. Clerk, London. | S. M. | London. | 1 : 11 : 13 |
| Doe, G. D. | Ditto | ,, | ,, | 17 : 8 : 13 |
| Paine, F. J. | ,, | S. E. | ,, | 1 : 10 : 13 |
| Pethurst, A. E. | ,, | E. | ,, | 19 : 10 : 13 |
| McNally, W. J. | ,, | S. M. | ,, | 16 : 8 : 13 |
| Bristow, A. W. | ,, | S. E. | ,, | 9 : 11 : 13 |
| Eadie, J. L. | 3rd Cl. Clerk Provs. | N. W. | Sc. W. | 7 : 9 : 13 |
| Howarth, H. | Ditto | Sc. W. | N. W. | ,, |
| Quigley, P. J. | ,, | London. | Sub. Woolwich | 14 : 9 : 13 |
| Davies, A. A. | ,, | N. | S. M. | 21 : 9 : 13 |
| Bott, J. T. | ,, | ,, | ,, | 1 : 7 : 13 |
| Winton, T. | ,, | Sc. E. | S. E. | 28 : 9 : 13 |
| Palk, E. | ,, | S. L. | S. M. | ,, |
| Powell, S. A. | ,, | N. | ,, | 26 : 10 : 13 |
| Blower, A. W. | ,, | Sc. E. | N. | ,, |
| Cairns, T. | ,, | N. | S. M. | 2 : 7 : 13 |



Digitized by Google

## RETIREMENTS.

| Name. | Former. | | Particulars. | Date from which to take effect. |
|---|---|---|---|---|
| | Rank. | District. | | |
| James, W. G. . . . | Engr. 2nd Cl. | Lond. Dist. | Superannuated | 8 : 9 : 13 |
| Hardie, J. J. . . . | Exec. Engr. | ,, | ,, | 7 : 9 : 13 |
| Bathurst, N. . . . | Engr. 1st Cl. | Eastern Dist. | ,, | 14 : 8 : 13 |

## DEATHS.

| Name. | Rank. | District. | Date. |
|---|---|---|---|
| Heather, T. . . . | Exec. Engr. | Met. Power | 27 : 10 : 13 |
| Whittingham, N. S. . . | Clk. 2nd Cl. Provs. | S. Western | 18 : 11 : 13 |
| May, H. C. . . . | Junior Engr. | E. in C. O. | 24 : 10 : 13 |


## BOARD OF EDITORS.

J. SINNOTT, M.I.E.E., Chairman.
A. W. MARTIN, A.M.I.E.E.
A. C. BOOTH.
J. W. ATKINSON, A.M.I.E.E.
A. O. GIBBON, A.M.I.E.E.
W. T. HARRIS.
W. CRUICKSHANK, A.M.I.E.E., Managing Editor.


## COMMUNICATIONS.

All Remittances and Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, G.P.O. West, London, E.C.

A few copies of each of the following numbers of the JOURNAL are required by the Board: Part 1, Vol. 1; Part 2, Vol. 3; Part 1, Vol. 5, and Part 2, Vol. 5. Full price will be paid for copies in good condition, or other numbers can be sent in exchange. The journals may be sent to the Managing Editor direct, or through the local agents.



Digitized by Google

# THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

VOL. 6 PART 1 APRIL 1913

ADVERTISEMENT INDEX see page xx.

Digitized by Google

ESTABLISHED 1879.

THE

# LONDON ELECTRIC WIRE COMPANY AND SMITHS, LTD.

Telegrams: "Electric, London." Telephone: No. 3105 London Wall.

Playhouse Yard, Golden Lane, London, E.C.

*MANUFACTURERS OF*

## Every Description of Cables & Wires for Electrical Purposes.

**Cotton-Covered & Braided Wires, Strips & Cables.**
**Silk-Covered Wires** for Electrical Instruments.
**Enamel Insulated Wires.**
**Multiple Cables** for Telephones, &c.
**Flexible Cords** of all descriptions for Incandescent Lamps, &c.
**Dynamo Brushes.**
**"Platinoid," "Eureka," AND OTHER High Resistance Wires.**

## Antwerp Telephone & Electrical Works, ANTWERP.

Manufacturers of

# TELEPHONIC APPARATUS

OF EVERY DESCRIPTION.

Wall Sets
Table Sets
Switchboards
Standard and Multiple
Domestic Sets

Bells
Receivers
Transmitters
All Accessories

Sole Agents for the United Kingdom—

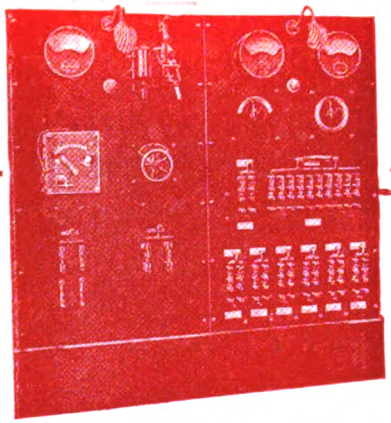
## *W. F. DENNIS & CO.,*

**49, QUEEN VICTORIA STREET, LONDON.**

**Stores: MILLWALL DOCKS, E.**

**Telegrams: "FREDENNIS, LONDON." Telephone: BANK 343.**

Digitized by Google



As supplied to

The Melbourne Post Office.

# POWER SWITCHBOARDS

## ESTIMATES ON APPLICATION.

## THE INDIA-RUBBER, GUTTA-PERCHA and TELEGRAPH WORKS CO., LTD.

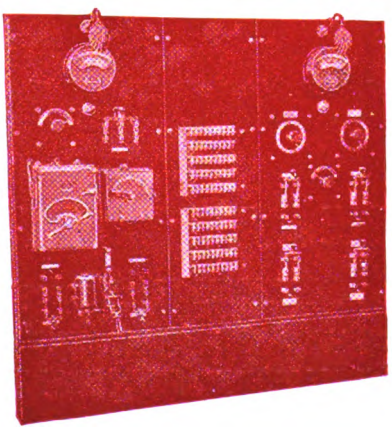
**HEAD OFFICES—106, Cannon Street, London, E.C.**
**WORKS—Silvertown, London, E.**

**Telegrams**—HEAD OFFICES: "Silvergray, London." WORKS: "Graysilver, London.

**Branches:**

| | | |
|---|---|---|
| BELFAST. | CARDIFF. | MANCHESTER. |
| BIRMINGHAM. | DUBLIN. | NEWCASTLE-ON-TYNE. |
| BRADFORD. | GLASGOW. | PORTSMOUTH. |
| BRISTOL. | LIVERPOOL. | SHEFFIELD. |

## For TELEGRAPH & TELEPHONE Purposes



As supplied to

The Launceston Post Office, Tasmania.

Digitized by Google

# JOHNSON AND PHILLIPS LTD
VICTORIA WORKS
CHARLTON. S.O. KENT
ESTABLISHED 1875.

## MULTIPLE TWIN DRY CORE TELEPHONE CABLES.

RUBBER INSULATED CABLES, PAPER INSULATED LEAD COVERED CABLES FOR POWER AND LIGHTING PURPOSES.

## SWITCH BOARDS
For Power and Lighting.

## FREQUENCY METERS,
Ammeter and Voltmeters.

## TRANSFORMERS.

## FLAME ARC LAMPS.
The "METROFLAM" Lamp burns 120 hours at one trim.
Has the LOWEST RUNNING COSTS.


Printed and Published by H. Alabaster, Gatehouse & Co., at 4, Ludgate Hill, London.

Digitized by Google

LORIME AUTOMATIC.

INDEXED

# THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

VOL. 6 PART 2

JULY 1913

Digitized by Google

ADVERTISEMENT INDEX

Price 2/- net

ESTABLISHED 1879.

THE

# LONDON ELECTRIC WIRE COMPANY AND SMITHS, LTD.

Telegrams: "Electric, London." Telephone: No. 3105 London Wall.

Playhouse Yard, Golden Lane, London, E.C.

*MANUFACTURERS OF*

## Every Description of Cables & Wires for Electrical Purposes.

**Cotton-Covered & Braided Wires, Strips & Cables.**
**Silk-Covered Wires** for Electrical Instruments.
**Enamel Insulated Wires.**
**Multiple Cables** for Telephones, &c.
**Flexible Cords** of all descriptions for Incandescent Lamps, &c.
**Dynamo Brushes.**
**"Platinoid," "Eureka," AND OTHER High Resistance Wires.**

---

## Antwerp Telephone & Electrical Works,
ANTWERP.

Manufacturers of

# TELEPHONIC APPARATUS

OF EVERY DESCRIPTION.

**Wall Sets**
**Table Sets**
**Switchboards**
Standard and Multiple
**Domestic Sets**

**Bells**
**Receivers**
**Transmitters**
**All Accessories**

Sole Agents for the United Kingdom—

## *W. F. DENNIS & CO.,*

**49, QUEEN VICTORIA STREET, LONDON.**

Stores: MILLWALL DOCKS, E.

Telegrams: "FREDENNIS, LONDON." Telephone: BANK 343.

Digitized by Google

INDEXED

# THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

VOL. 6 PART 3 OCT: 1913

INDEX

Digitized by Google

ESTABLISHED 1879.

THE

# LONDON ELECTRIC WIRE COMPANY AND SMITHS, LTD.

Telegrams: "Electric, London." Telephone: No. 3105 London Wall.

Playhouse Yard, Golden Lane, London, E.C.

*MANUFACTURERS OF*

**Every Description of Cables & Wires for Electrical Purposes.**

**Cotton-Covered & Braided Wires, Strips & Cables.**
**Silk-Covered Wires** for Electrical Instruments.
**Enamel Insulated Wires.**
**Multiple Cables** for Telephones, &c.
**Flexible Cords** of all descriptions for Incandescent Lamps, &c.
**Dynamo Brushes.**
**"Platinoid," "Eureka," AND OTHER High Resistance Wires.**

# Whittaker's Books.

THE BAUDOT PRINTING TELEGRAPH SYSTEM. By H. W. PENDRY, Central Telegraph Office. With 72 Illustrations. **2s. 6d.** net (postage **3d.**).

THE RADIO-TELEGRAPHISTS' GUIDE AND LOG-BOOK. A Manual of Wireless Telegraphy for the Use of Operators. By W. H. MARCHANT. With 90 Illustrations. Pocket size. **4s. 6d.** net (postage **2d.**).

THE PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By JOSEPH POOLE, A.M.I.E.E. (Wh.Sc.). Fifth Edition, Revised and Enlarged. With 550 Illustrations. **6s.** net (postage **5d.**).

WIRELESS TELEGRAPHY AND TELEPHONY. By W. J. WHITE, A.M.I.E.E. Second Edition, Revised and Enlarged. With 100 Illustrations. **2s. 6d.** net (postage **3d.**).

TELEGRAPHY. A Detailed Exposition of the Telegraph System of the British Post Office. By T. E. HERBERT, A.M.I.E.E., Engineer of Postal Telegraphs. Second Edition, Revised. With 509 Illustrations. **6s. 6d.** net (postage **5d.**).

ELEMENTARY TELEGRAPHY. A Manual for Students. By H. W. PENDRY, Central Telegraph Office, London. With 178 Illustrations. **2s. 6d.** net (postage **3d.**).

WHITTAKER'S ELECTRICAL ENGINEER'S POCKET-BOOK. Edited by KENELM EDGCUMBE, A.M.I.C.E., M.I.E.E. Third Edition, Entirely Rewritten and Enlarged. With 180 Illustrations. Gilt edges. **5s.** net (postage **4d.**).

*Catalogue of Books on Electricity, Engineering, etc., post free.*

WHITTAKER & CO., 2, White Hart St., Paternoster Sq., London, E.C.

Digitized by Google

INDEXED

# THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

VOL. 6 PART 4 JAN: 1914

ADVERT[illegible] T. INDEX

Digitized by Google

ESTABLISHED 1879.

THE

# LONDON ELECTRIC WIRE COMPANY AND SMITHS, LTD.

Telegrams: "Electric, London." Telephone: No. 3105 London Wall.

Playhouse Yard, Golden Lane, London, E.C.

*MANUFACTURERS OF*

## Every Description of Cables & Wires for Electrical Purposes.

**Cotton-Covered & Braided Wires, Strips & Cables.**
**Silk-Covered Wires** for Electrical Instruments.
**Enamel Insulated Wires.**
**Multiple Cables** for Telephones, &c.
**Flexible Cords** of all descriptions for Incandescent Lamps, &c.
**Dynamo Brushes.**
**"Platinoid," "Eureka," AND OTHER High Resistance Wires.**

**NOW READY.**

# "Technical Instruction for Wireless Telegraphists."

An authoritative Text-Book on Wireless Telegraphy based on practical experience.

**TO BE OBTAINED FROM ALL BOOKSELLERS OR RAILWAY BOOKSTALLS.**

295 pp. :: :: **Price 3/6** Profusely Illustrated.

*OR POST FREE FROM*

THE PUBLISHERS, THE MARCONI PRESS AGENCY, Ltd.,
MARCONI HOUSE, STRAND, W.C.

Digitized by Google

# British Insulated & Helsby Cables Ltd.

**Manufacturers of**

ALL CLASSES OF

## Paper & Rubber Cables

:: :: FOR :: ::

**Power, Lighting, Telephone, or Telegraph Purposes.**

WE HAVE SPECIALISED IN

## CONTINUOUSLY LOADED PAPER TELEPHONE CABLES.

THESE CABLES CAN BE HANDLED EXACTLY LIKE AN ORDINARY CABLE & REQUIRE NO MORE ATTENTION FOR MAINTENANCE; BUT THEIR SPEAKING :: :: EFFICIENCY IS FAR SUPERIOR. :: ::

**Head Office: PRESCOT, Lancashire.**

**Works: Prescot & Helsby.**


Digitized by Google

# The Post Office Electrical Engineers' Journal.

*A QUARTERLY JOURNAL.*

## CONTENTS FOR JANUARY, 1914.

**COPYRIGHT.**—The entire contents of this Journal are covered by general copyright, and special permission is necessary for reprinting long extracts, but Editors are welcome to use not more than one third of any article provided credit is given at the beginning or end thus: "From the 'Post Office Electrical Engineers' Journal.'"


| | PAGE |
|---|---|
| **FRONTISPIECE—** | |
| DIGGING THE TRENCH FOR THE NEW ANGLO-GERMAN CABLE. THE CABLE SHIP "STEPHAN" IS SEEN LYING CLOSE INSHORE. | |
| **TELEGRAPHS—** | |
| A NEW ANGLO-GERMAN TELEGRAPH CABLE.—A. C. BOOTH ... ... | 321 |
| PROGRESS OF THE BAUDOT SYSTEM.—A. C. BOOTH ... ... ... | 324 |
| SECONDARY CELL MAINTENANCE.—J. G. L. ... ... ... | 336 |
| **CALCULATIONS—** | |
| ALTERNATING CURRENT CALCULATIONS.—F. ADDEY, B.Sc., A.M.I.E.E. (*continued from page* 195) ... ... ... ... ... | 342 |
| **WIRELESS—** | |
| RE-ORGANISATION OF THE BRITISH COAST COMMUNICATION WIRELESS SERVICE.—E. S. PERRIN, B.Sc., A.M.INST.C.E., AND F. W. DAVEY ... | 351 |
| **TRANSPORT—** | |
| RECENT DEVELOPMENTS IN TRANSPORTATION.—H. C. GUNTON, M.I.E.E. ... | 365 |
| **PUMPS—** | |
| PNEUMATIC TUBE HAND PUMPS.—A. B. EASON, M.A.... .. ... | 378 |
| **TELEPHONES—** | |
| THE NEW ANGLO-IRISH TELEPHONE CABLE.—J. G. H. ... ... | 381 |
| **AWARDS—** | |
| GHENT EXHIBITION ... ... ... ... ... ... | 383 |
| **INSPECTORS—** | |
| RULES AND REGULATIONS TO BE OBSERVED BY INSPECTORS IN THE SERVICE OF THE ELECTRIC TELEGRAPH COMPANY (1850) ... ... ... | 385 |
| **EDITORIAL—** | |
| WORKMEN'S TECHNICAL CLASSES ... ... ... ... | 387 |
| **BOOKS—** | |
| BOOK REVIEWS ... ... ... ... ... ... | 390 |
| **NOTES—** | |
| HEADQUARTERS NOTES ... ... ... ... ... | 395 |
| LONDON ENGINEERING DISTRICT NOTES ... ... ... ... | 398 |
| **OBITUARY** ... ... ... ... ... ... | 401 |
| **INSTITUTION—** | |
| INSTITUTION NOTES ... ... ... ... ... ... | 410 |
| **LOCAL CENTRE NOTES** ... ... ... ... ... | 413 |
| **SOCIETY—** | |
| THE POST OFFICE TELEPHONE AND TELEGRAPH SOCIETY OF LONDON ... | 418 |
| **CHESS CLUB** ... ... ... ... ... ... | 424 |
| **RETIREMENTS IN 1913** ... ... ... ... ... | 424 |
| **LITERATURE—** | |
| REFERENCES TO CURRENT TECHNICAL LITERATURE ... ... ... | 428 |
| **LIBRARY NOTES** ... ... ... ... ... ... | 429 |
| **Mr. A. E. McCLOSKEY** ... ... ... ... ... | 429 |
| **STAFF CHANGES** ... ... ... ... ... ... | 430 |


PUBLISHERS:

H. ALABASTER, GATEHOUSE & Co., 4, LUDGATE HILL, E.C.

**Price 1/- net, post free, 1/3.** | **Annual Subscription, postage inclusive, 5/-, payable in advance.**

**Editorial Communications see page 432.**

Digitized by Google

THE

**British L.M. Ericsson Mfg. Co.,**

**Old Serjeants' Inn Chambers,**
**4, Chancery Lane, London, W.C.**

**Telegrams:**
**"ERICSSON, FLEET, LONDON."**

**Telephone:**
**HOLBORN 5340-1.**

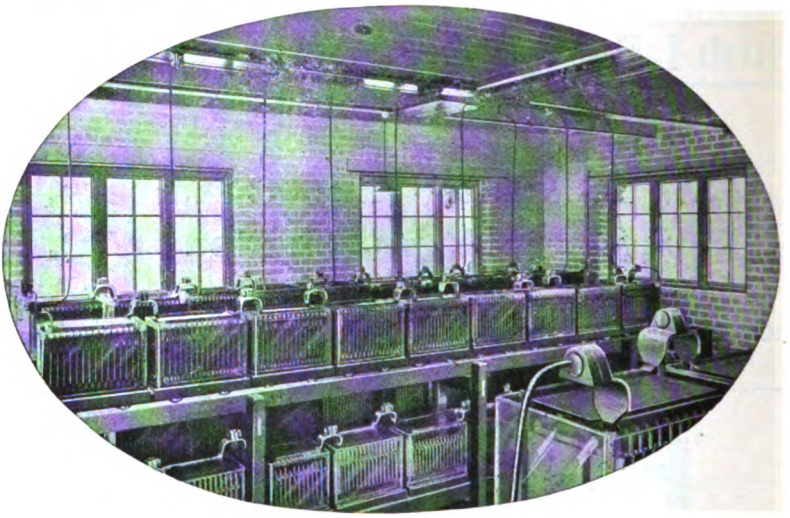
# H.K. 100.

# Secret Intercommunication Set.

## BATTERY RINGING.

**Perfect in Construction.** **Perfect in Action.**

Digitized by Google



# HART ACCUMULATOR

**CO., LTD.**

## THE Storage Battery for ALL Purposes.

## SPECIAL CELLS

— FOR —

**TELEGRAPH,**
**TELEPHONE,**
**LABORATORY and**
**TESTING WORK.**

**INQUIRIES INVITED.**

**Head Office and Works: STRATFORD, LONDON.**

Telephones: EAST 1306. 1307.

Telegrams: "HARTMOSSEL, BOCHURCH, LONDON."

Digitized by Google

# "St. Martin's-le-Grand"

## The Post Office Quarterly Magazine.

**Circulates throughout the Post Offices of the United Kingdom, the British Colonies, and Foreign Countries.**

**3/- PER ANNUM. SINGLE COPIES 9d.**

N.B.—Any profit remaining after due provision has been made for carrying on the Magazine is devoted to the furtherance of benevolent and philanthropic objects connected with the Post Office. An Annual Balance Sheet is published in the Magazine.

*Hon. Treasurer.*—ARTHUR G. FERARD, Esq.
*Hon. Editor.*—EDWARD BENNETT, Esq.
*Assistant Editor.*—R. W. HATSWELL, Esq.

*All Communications to be addressed—*
**c/o Messrs. W. P. GRIFFITH & SONS, Ltd., Old Bailey, London, E.C.**

*ADVERTISEMENTS.*
*For Terms apply to Messrs. Pratt & Co., 9, Essex Street, Strand, London.*

# "The Zodiac,"

## The Cableman's Paper.

**A Monthly Magazine representing the Social Life of the World of Cablemen in the Home Countries and Overseas: their Sport, Art, Literature, and the Gossip of the Ships and Stations.**

***Illustrated with beautifully reproduced Photographs and many charming Drawings.***

**SIXPENCE MONTHLY.**

YEARLY SUBSCRIPTION, Post Free, to any part of the World, **6s.**

**Published by THE ZODIAC PUBLISHING CO., Ltd.,**
**Electra House, Finsbury Pavement,**
**LONDON, E.C.**


Digitized by Google

# STANDARD TECHNICAL WORKS

**Of Direct Interest to all P.O. Electrical Engineers.**

**AUTOMATIC TELEPHONY.** Being a Reprint from 'Electricity' of the serial describing the Strowger Automatic Telephone System as adopted by the P.O. Telephone Dept. By S. TURNER, Engineer-in-Chief's Office, G.P.O. Paper Cover. 32 pp., illustrated. **6d.** net, **7d.** post free.

**TELEPHONE TROUBLES, AND HOW TO FIND THEM.** On both the Magneto and C.B. Systems. Sixteenth Edition. Thousands in use all over the world. Price **7d.** net, post free.

**HANDBOOK FOR WIRELESS & INLAND TELEGRAPH OPERATORS.** By CHARLES WARD. A useful and practical work. Price (post free) **1s. 1d.** net.

**THE HANDY ELECTRICAL DICTIONARY.** By W. L. WEBER, M.E. Is a work which should have a place in the vest-pocket of every electrician who aspires to a higher position. It tells you just what over 4800 distinct words, terms and phrases really mean, and does it clearly. Nicely bound in cloth, with alphabetical thumb index, size 5¼ × 2¾ ins. Price (post free) **1s. 1d.** cloth, and **1s. 8d.** leather, gilt edges.

**THE TELEGRAPHISTS' AND TELEPHONISTS' NOTE BOOK.** Third Edition. Handy pocket size, 5¼ × 3¾ inches, with squared pages for Memoranda, Calculations, etc. Highly spoken of by leading P.O. officials. Price **1s. 6d.** net, or **1s. 7d.** post free.

**THE HUGHES AND BAUDOT TELEGRAPHS.** By ARTHUR CROTCH. A clearly written and well illustrated work, giving a detailed description of these type-printing telegraph systems. Invaluable to students, as a knowledge of both systems is now demanded by the examiners. Cloth, 8vo. **1s. 6d.** net, **1s. 8d.** post free.

**TELEPHONE ERECTION AND MAINTENANCE.** A Handbook for the Contractor and Wireman. By HERBERT G. WHITE. Highly recommended by the Technical Press. Cloth, 8vo. 129 pp., illustrated. **1s. 6d.** net, **1s. 9d.** post free.

**THE TELEGRAPHISTS' GUIDE.** By BELL and WILSON. A New (seventh) edition of this standard text-book was recently published. It is absolutely the best and most up-to-date work of its kind on the market, and has no less than 78 new illustrations and diagrams. For class teachers and students alike it is invaluable, and the repeated calls for fresh editions prove its merit. Price **2s.** net, or **2s. 3d.** post free.

**CALCULATIONS IN TELEGRAPHY AND TELEPHONY (Ordinary and Honours Grades).** By H. P. FEW, Silver Medallist, etc. Contains full solutions to the numerical problems set by the C. and G. Inst. in the Ordinary and Honours Grade of Telegraphy and Telephony from 1900 to 1910. **2s.** net, **2s. 3d.** post free.

**QUESTIONS AND SOLUTIONS IN TELEGRAPHY AND TELEPHONY.** By H. P. FEW. Includes model solutions to the C. and G. Exams. 1904–1911, as well as to several typical questions set at the Post Office Departmental Exams. for Overseerships. Third edition. Cloth. 178 pages, 144 illustrations. **2s. 6d.** net, or **2s. 9d.** post free.

**GUIDE TO THE PRACTICAL ELEMENTS OF ELECTRICAL TESTING.** By J. WARREN. A useful work, clearly expressed and well illustrated. 186 pp., cloth, 8vo. **3s. 6d.**, or **3s. 9d.** post free.

**PRACTICAL TELEPHONY.** By JAS. BELL, A.I.E.E., and S. WILSON, A.M.I.E.E. A simple and practical handbook suitable for students, artisans, etc. Copiously illustrated. Latest edition. Tenth thousand. **3s. 6d.** net, **3s. 9d.** post free.

**MANUAL OF WIRELESS TELEGRAPHY.** By Comdr. S. S. ROBISON, U.S.N. The standard text-book for Marconi students. Recommended by the Editor of the P.O.E.E. Journal, The Electrical Review, and by all the leading teachers. Latest Edition. Cloth, 8vo. 212 pp., illustrated. **7s. 6d.** net, **7s. 10d.** post free.

**PRACTICAL TELEGRAPHY.** By H. W. JENVEY, M.I.E.E., Electrical Engineer to the Postal Department, Victoria. A standard text-book specially suitable for Colonial telegraphists. Fourth edition, revised and enlarged. Cloth, 8vo. 444 pp. and 83 illustrations. **10s. 6d.** net, **10s. 9d.** post free.

**TELEPHONY.** By SAML. G. McMEEN and KEMPSTER B. MILLER, M.E. The latest and best book published on the Theory and Practice of All Phases of Telephone Work. 960 pp., 700 Illustrations. **17s.** net.

**STANDARD TELEPHONE CONSTRUCTION METHODS.** By FRANK B. HALL. This book contains 250 full-page drawings of standard materials and methods of construction; 280 pages of specifications and tables. No detail from sub-station to main distributing frame omitted. A book every telephone man should have. Loose leaf pocket size. Price **17s.** net, post free.

*Sent Post Free at Prices stated by*

**S. RENTELL & CO., Ltd., 36, Maiden Lane, Strand, LONDON.**

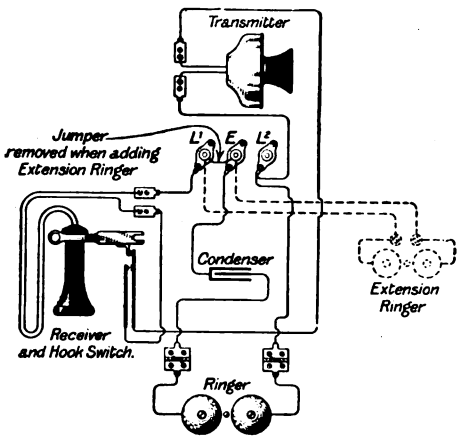
WRITE FOR CATALOGUE.


Digitized by Google

# PEEL-CONNER TELEPHONE WORKS, LTD.

**MANUFACTURERS and INSTALLERS of all sizes and types of SWITCHBOARDS and SUBSCRIBERS' INSTRUMENTS.**

**SPECIALISTS in LARGE MULTIPLE CENTRAL BATTERY & GENERATOR CALL EXCHANGE EQUIPMENTS.**




CENTRAL BATTERY TELEPHONE CIRCUIT.
Peel-Conner Telephone Works Ltd.

**EQUALLY EFFICIENT for long distance or local service.**

**NO induction coil necessary.**

**TRANSMISSION unequalled.**

**TABLE SETS require TWO conductor cord only.**

**RECEIVING greatly improved by use of specially designed ELECTRO-MAGNETIC RECEIVER containing NO PERMANENT MAGNET rendering deterioration or loss of permanent adjustment impossible.**

*Head Office:*

**PEEL WORKS, SALFORD, LANCS.**

Telephones: 2183 & 2186 CENTRAL.
Telegrams: SPRINGJACK MANCHESTER.

*London Office:*

**MIDLAND BANK CHAMBERS, QUEEN VICTORIA ST., E.C.**

Telephone: 673 LONDON WALL.
Telegrams: PEELCONTEL LONDON.


Digitized by Google

# The "Electrical Review."

Established
—1872—

THE OLDEST AND YET MOST UP-TO-DATE
ELECTRICAL NEWSPAPER IN THE WORLD

---

## Electric Traction - -
## Power, Lighting, &c.

## Reliable, Unbiassed,
## Original, Invaluable.

HAS BY FAR THE LARGEST CIRCULATION OF ANY
ELECTRICAL INDUSTRIAL PAPER IN GREAT BRITAIN.

---

## UNRIVALLED AS AN ADVERTISING MEDIUM.

Scale of Charges for Trade Advertisements on application.
Special Prepaid Rate of Advertisements of Situations Vacant or Wanted.

---

Published Friday 9 a.m.,
4½d. Post Free.

Advertisements received up
to 9.30 a.m. on Thursday.

---

LONDON:

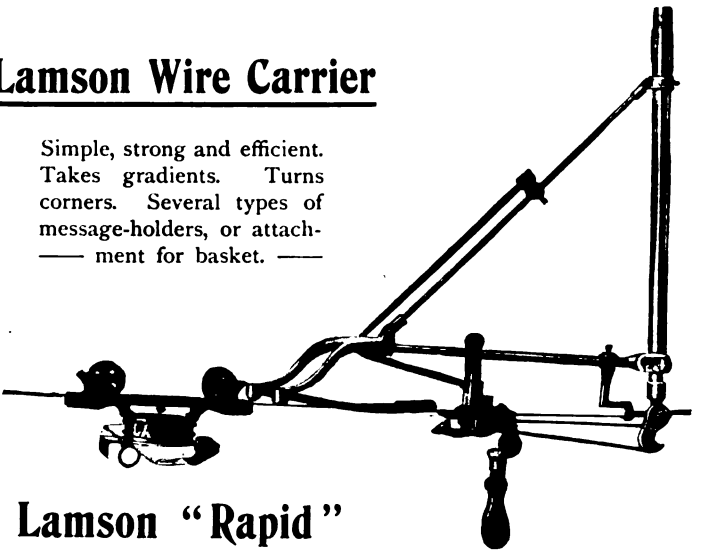
H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, E.C.


Digitized by Google

## Lamson Wire Carrier

Simple, strong and efficient. Takes gradients. Turns corners. Several types of message-holders, or attachment for basket.



## Lamson "Rapid" Message Carrier

(As used by H.M. Post Office).

Write for particulars to

**LAMSON STORE SERVICE CO., Ltd., 20, Cheapside, E.C.**

---

**Telegrams:**
**"INSTANTLY, BARB, LONDON."**

**Ebonite.**

**Telephone:**
**3186 CENTRAL.**

# H. TRAUN & SONS,

## 25, GOSWELL ROAD, E.C.

**F. WINTER, Manager.** **G. ALMENRÄDER, Assist. Manager.**

### Contractors to the Post Office

And many other Government Departments.

### MANUFACTURERS OF EBONITE AS A SPECIALITY,

With an unrivalled experience of over **57 years**, which we are always willing to place at the disposal of our customers.

**Over 2000 hands** are constantly employed at our works turning out **EBONITE** in any form or shape.

**Vulcanite.**


Digitized by Google

# TUBULAR STEEL TRANSMISSION TOWERS

## TRAMWAY, TELEGRAPH & TELEPHONE POLES

**High-Pressure Steam Pipes for Generator Stations**

CATALOGUES ON APPLICATION

GLASGOW **STEWARTS AND LLOYDS, LTD.** BIRMINGHAM


# LIST OF PROFESSIONAL PAPERS

PUBLISHED BY

## THE COUNCIL OF THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

| | Price. | Post free. |
|---|---|---|
| **"G.P.O. New Electric Power Scheme."**—H. C. GUNTON, M.I.E.E. ... ... ... ... ... | 1s. | 1s. 2d. |
| **"The Methods of Statistics."**—A. S. RENSHAW ... ... | 9d. | 11d. |
| **"Notes on Mechanical Conveyors and their Adaptability for use in Postal Sorting Offices."**—E. W. PETTIT ... | 6d. | 8d. |
| **"Precautions Against Fire."**—A. J. STUBBS, M.I.C.E., M.I.E.E. | 6d. | 7d. |
| **"The Various Systems of Multiple Telegraph."**—Major W. A. J. O'MEARA, C.M.G., R.E. ... ... ... | 6d. | 7d. |
| **"Quadruple Telegraph System."**—C. J. MERCER ... | 6d. | 7d. |
| **"Telegraphic History."**—H. R. KEMPE, M.I.C.E., M.I.E.E. ... | 6d. | 7d. |
| **Abstracts of Papers read before the Institution, Sessions 1911–12, 1912–13.—"Telephone Transmission (Reflection and its Effects)"** (A. G. LEE, B.Sc.); **"Submarine Cables across Rivers and Docks"** (H. CRANAGE); **"Lead and Lead-covered Cables (A Physical Analysis)"** (O. P. MOLLER) ... ... ... ... | 9d. | 11d. |
| **"Machine Switching in Telephony."**—B. O. ANSON ... | 9d. | 10d. |


## H. ALABASTER, GATEHOUSE & Co.

4, LUDGATE HILL, LONDON, E.C.

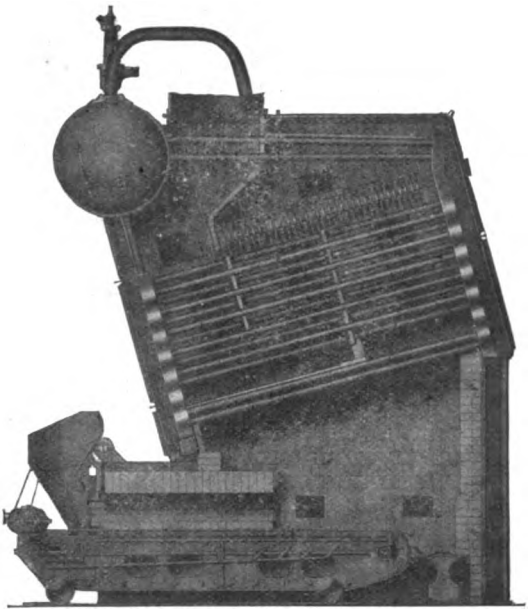

Digitized by Google

# BABCOCK & WILCOX

PATENT LTD.

## WATER-TUBE STEAM BOILERS.

OVER { 10,000,000 H.P. Land Type / 2,700,000 H.P. Marine Type } Installed or on Order.



BABCOCK & WILCOX PATENT WATER-TUBE STEAM BOILER
(Marine-Type for Land Purposes). (With part of Casing removed.)
Fitted with Patent Superheater and Patent Chain Grate Stoker.

**BABCOCK & WILCOX also Manufacture**

WHITE-FORSTER WATER-TUBE MARINE STEAM BOILERS.

| | |
|---|---|
| STEAM SUPERHEATERS. | COAL-CONVEYORS. |
| MECHANICAL STOKERS. | SUCTION ASH CONVEYORS. |
| ECONOMISERS. | ELECTRIC CRANES. |
| STEEL CHIMNEYS. | STEEL WORKS CHARGERS. |
| FEED-WATER HEATERS. | STEAM PIPING PLANTS. |
| WATER SOFTENERS AND PURIFIERS. | STRUCTURAL STEEL WORK. |

Telegrams: "BABCOCK, LONDON." HEAD OFFICES: Telephone: No. CITY 6470 (8 lines).

**Oriel House, Farringdon St., London, E.C.**

Works: RENFREW, SCOTLAND.


Digitized by Google

"Gate" Members of Heavy Steel Section.

Detachable Split Rings obviate Threading of Cord.

Fixing Lugs for either Roll-top, Flat-top Desks, or for Walls.

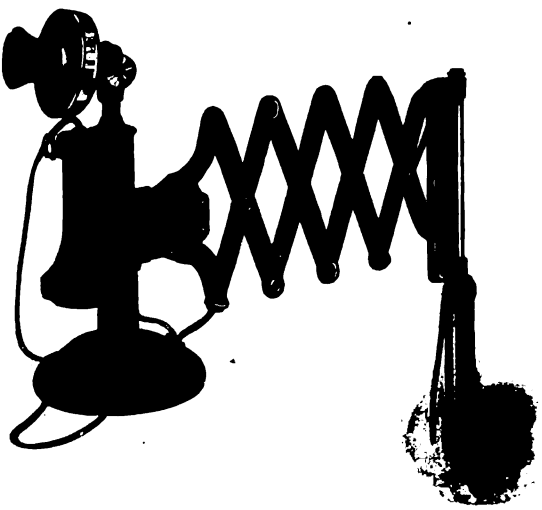
GREATLY INCREASED

STRENGTH.

In designing this Arm our efforts have been specially directed to the attainment of permanent rigidity and freedom from "sag" in use. The principle of the adjustment is of proved soundness & efficiency.

Western-Electric

IMPROVED



ADJUSTABLE

TRANSMITTER ARM.

If you are interested in a Telephone Support which is the "gate to convenience,"

*Write for Illustrated LEAFLET 20 E.*

"Life" is Double other Patterns.

Bracket Rotates on Solid ½-in. Steel Bar, not Weakened by Screw Threads.

Roller Bearings where Greatest Strain Occurs.

Western-Electric Company Limited.

NORTH WOOLWICH WORKS, LONDON, E.

Birmingham, Cardiff, Glasgow, Leeds, Sydney, Johannesburg, Buenos Aires.

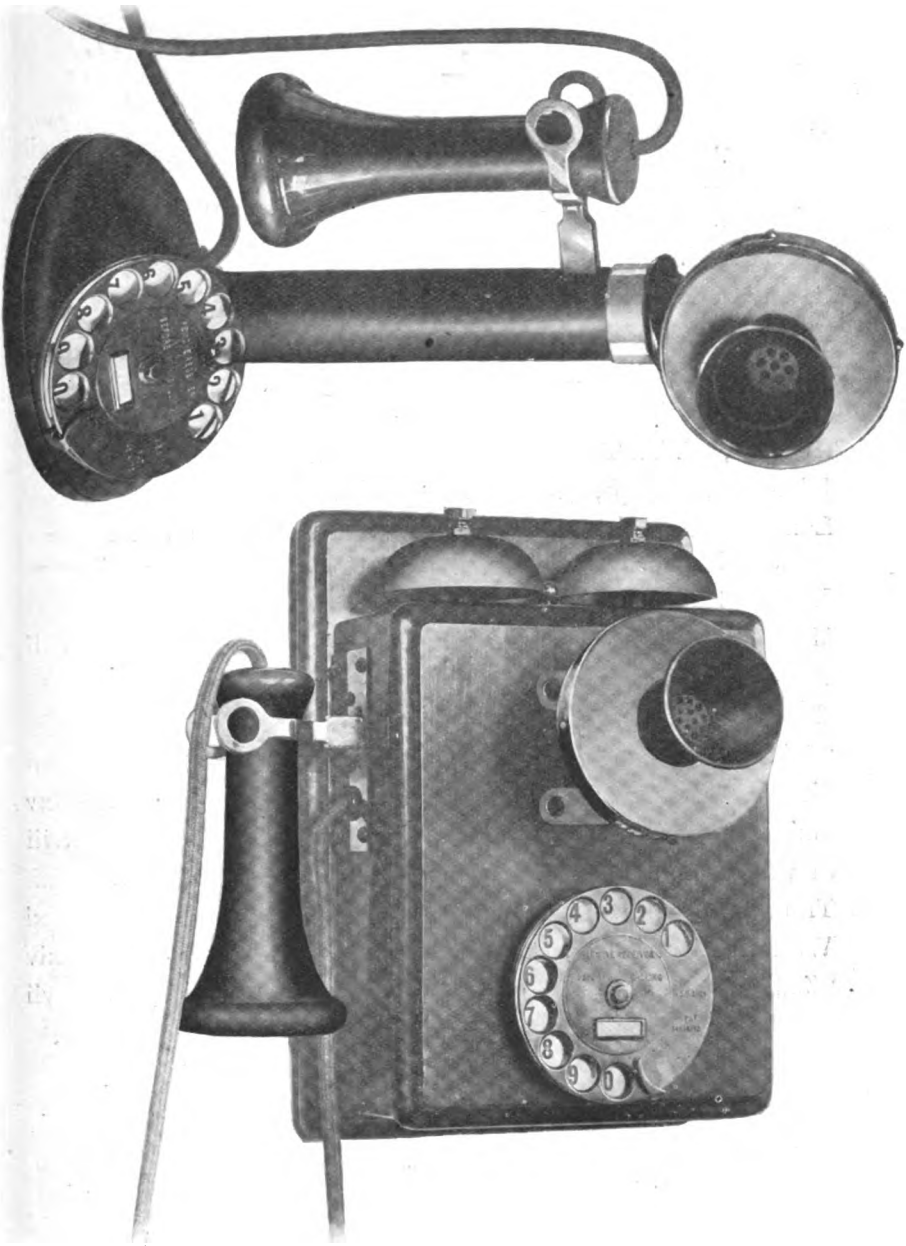
Digitized by Google

# SIEMENS BROTHERS & CO., Ltd.

***Electrical Engineers,***

## WOOLWICH, LONDON, S.E.

**Telegrams: "Siemens, Woolwich."** **Telephone: City 6400 (7 lines).**




**HOME BRANCHES:**

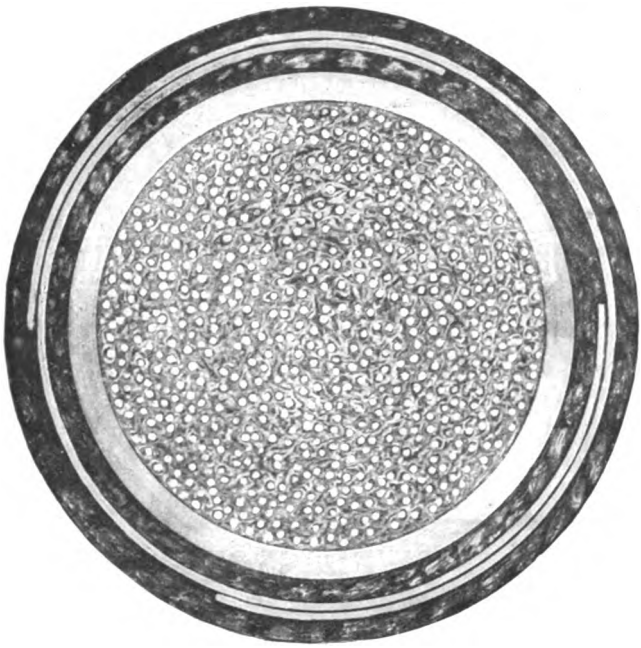
**Birmingham, Bristol, Cardiff, Glasgow, Manchester, Newcastle, Sheffield.**


Digitized by Google

# INDEX TO ADVERTISERS.


| | PAGE |
|---|---|
| Alabaster, H., Gatehouse & Co. ... ... | iv, x, and xii |
| Babcock & Wilcox, Ltd. ... ... ... ... | xiii |
| British Insulated and Helsby Cables, Ltd. ... ... | iii |
| British L.M. Ericsson Mfg. Co., Ltd. ... ... ... | v |
| Crystalate Mfg. Co., Ltd. ... ... ... ... | xix |
| Electrical Power Storage Co., Ltd. ... ... ... | xviii |
| 'Electrical Review' ... ... ... ... | x |
| Hart Accumulator Co., Ltd. ... ... ... ... | vi |
| Henley's, W. T., Telegraph Works Co., Ltd. ... ... | xvii |
| Johnson & Phillips, Ltd. ... ... ... ... | xx |
| Lamson Pneumatic Tube Co. Ld., and Lamson Store Service Co. Ld. ... ... ... ... ... | xi |
| London Electric Wire Co. & Smiths, Ltd. ... ... | ii |
| Marconi Press Agency, Ltd. ... ... ... ... | ii |
| Peel-Conner Telephone Works, Ltd. ... ... ... | ix |
| Rentell, S., & Co., Ltd. ... ... ... ... | viii |
| 'Saint Martin's-le-Grand' ... ... ... ... | vii |
| Siemens Bros. & Co., Ltd. ... ... ... ... | xv |
| Smith, Frederick, & Co. ... ... ... ... | xviii |
| Stewarts & Lloyds, Ltd. ... ... ... ... | xii |
| Traun, Dr. Heinr. & Sons ... ... ... .. | xi |
| Western Electric Co., Ltd. ... ... ... ... | xiv |
| 'Zodiac' ... ... ... ... ... ... | vii |


Digitized by Google



312 Pair 20 lb. Conductor
Dry Core Lead Covered
and Steel Tape Armoured
TELEPHONE CABLE.

# HENLEY'S
# TELEPHONE CABLES

are in use in all
parts of the World.

**W. T. Henley's Telegraph Works Co., Ltd.**
**Blomfield Street,**
**LONDON,**
**E.C.**

Digitized by Google

# E.P.S. Accumulators

ACCUMULATORS

FOR

All Purposes.

DRY BATTERIES

FOR

Telephones, &c.

ELECTRICAL POWER STORAGE CO., Ltd.,

4, Great Winchester Street, London, E.C.

Telegrams: "STORAGE, LONDON." 'Phone: 1253 LONDON WALL.

---

# FREDERICK SMITH & CO.,

Incorporated in

The London Electric Wire Co. & Smiths, Ltd.,

ANACONDA WORKS, SALFORD, MANCHESTER.

HARD DRAWN H.C. COPPER LINE WIRE.

Special Tinned H.C. Copper Wire.

COPPER TAPES AND BINDERS FOR LINE WIRE.

COPPER TROLLEY WIRE

SPECIAL NON-FOULING SECTIONS.

SILICIUM BRONZE WIRE

"C" Quality for Telephone Lines, &c.

ALUMINIUM WIRE & STRIP FOR ALL ELECTRICAL PURPOSES.


Digitized by Google

THE
# CRYSTALATE MFG. Co., LTD.
TONBRIDGE, KENT,
—— ENGLAND. ——

Telegrams:
"Crystalate, Hadlow."

Telephone:
No. 33 Hadlow.

# Telephone
## Fittings.

SPECIAL ATTENTION IS CALLED TO THIS

## Crystalate Mouthpiece

which has brass screw moulded in, infinitely increasing strength and lasting power.

**Ear and Mouthpieces**
. . . of every description. . .

**Insulators, Bushing Pieces, Washers & Handles, &c.**

Digitized by Google

# JOHNSON AND PHILLIPS LTD
VICTORIA WORKS
CHARLTON. S.O. KENT

ESTABLISHED 1875.

## MULTIPLE TWIN DRY CORE TELEPHONE CABLES.

RUBBER INSULATED CABLES, PAPER INSULATED LEAD COVERED CABLES FOR POWER AND LIGHTING PURPOSES.

## SWITCH BOARDS
For Power and Lighting.

## FREQUENCY METERS,
Ammeter and Voltmeters.

## TRANSFORMERS.

## FLAME ARC LAMPS.
The "METROFLAM" Lamp burns 120 hours at one trim.
Has the LOWEST RUNNING COSTS.


Printed and Published by H. Alabaster, Gatehouse & Co., at 4, Ludgate Hill, London.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

THE NEW YORK PUBLIC LIBRARY
REFERENCE DEPARTMENT

This book is under no circumstances to be taken from the Building

MAY 20 1915

NOV 30 1915

DEC 10 1915

JUL 28 1916

Digitized by Google

Digitized by Google